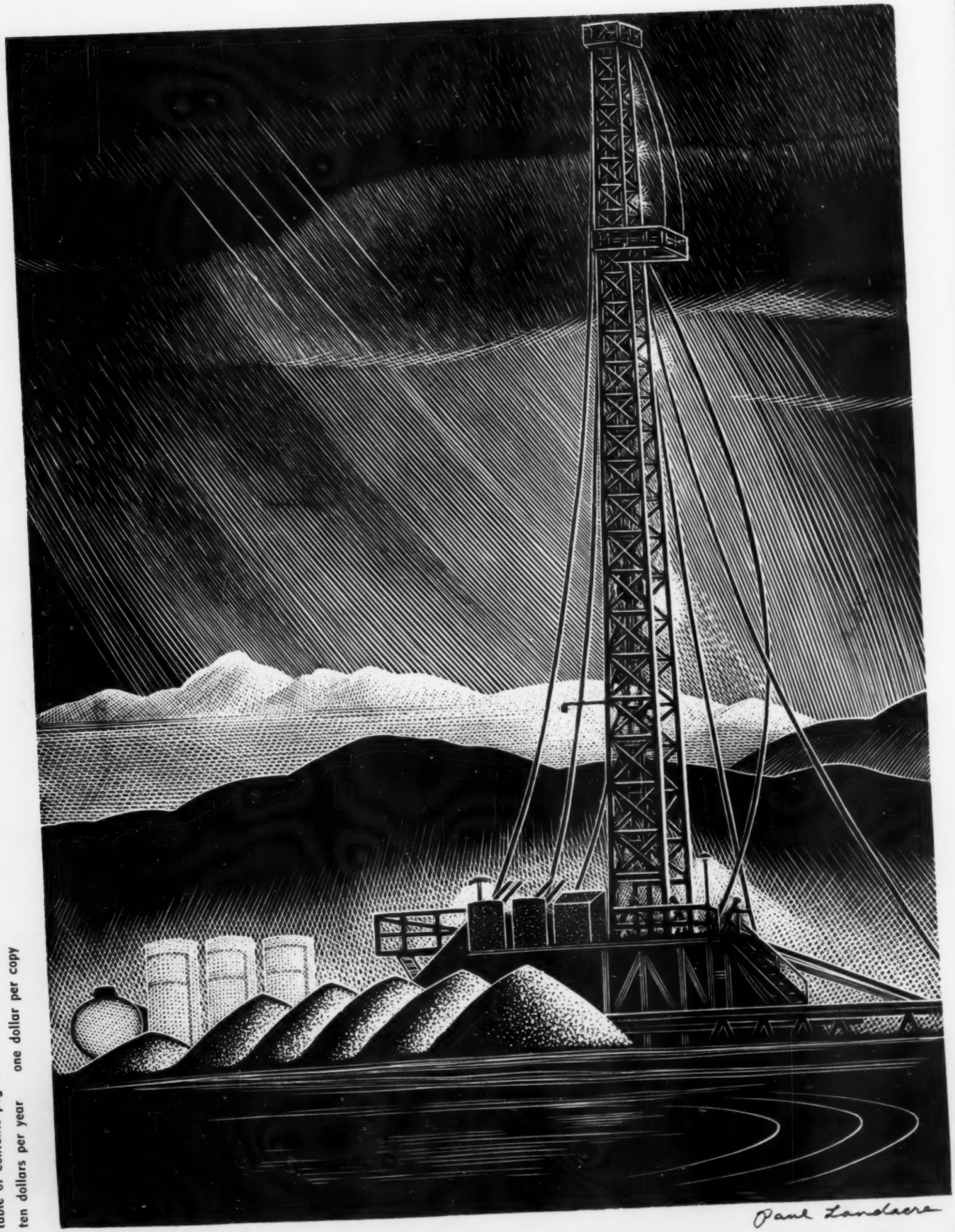
WORLD PETROLEUM

AUGUST 1958



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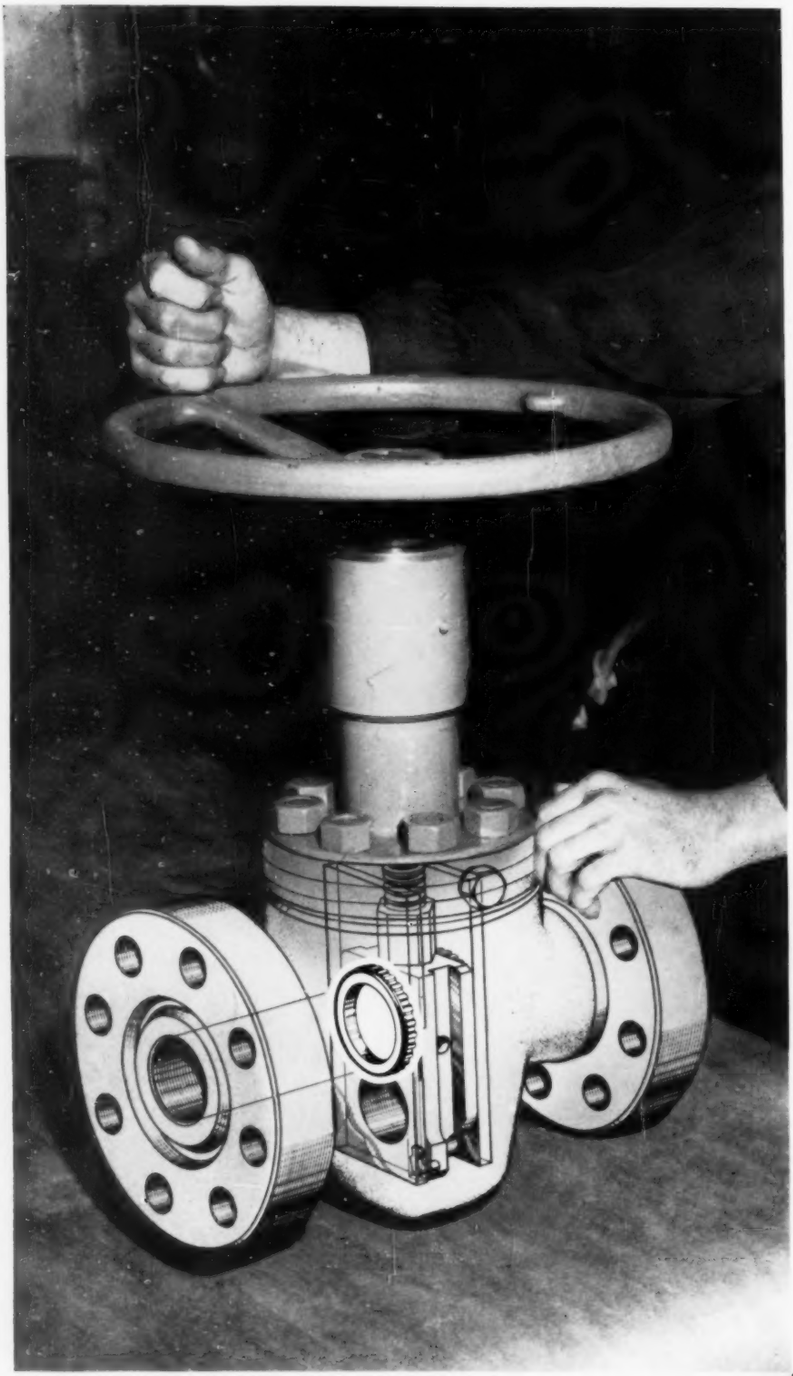

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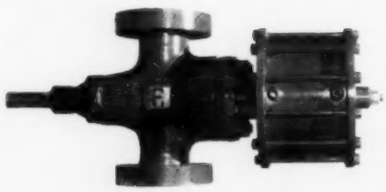

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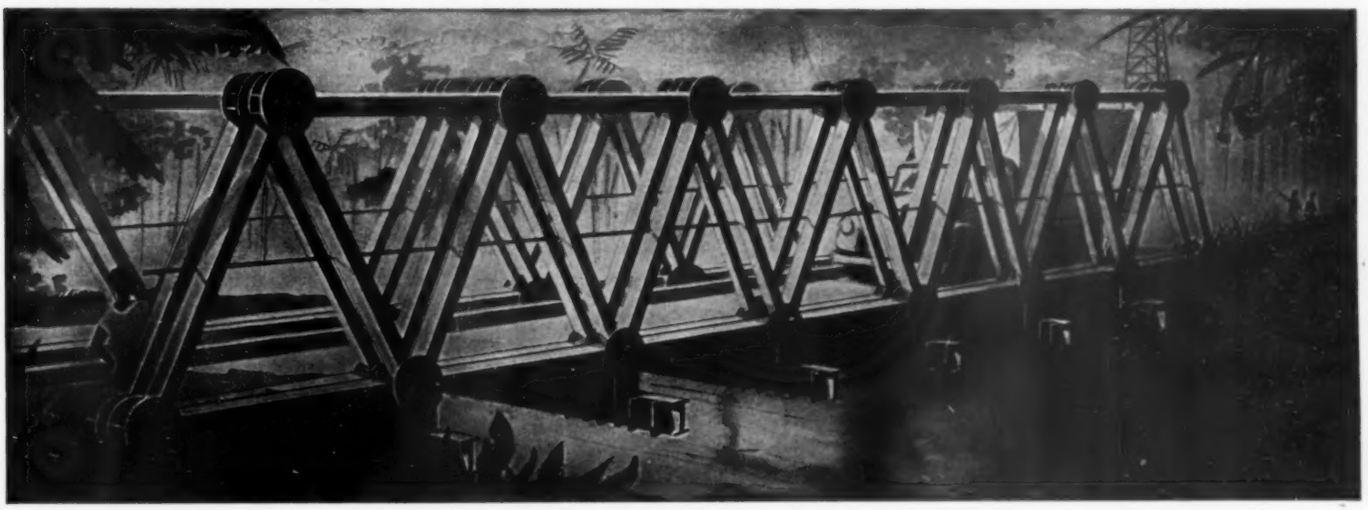

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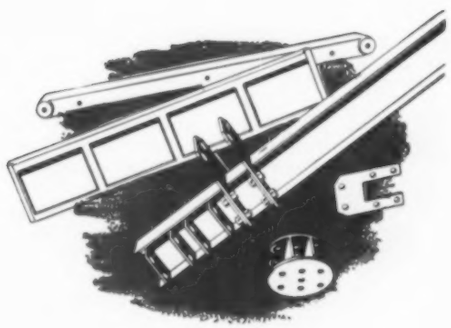

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Lummus Designing and Engineering Gas Conservation Plant on Lake Maracaibo for Compania Shell de Venezuela

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Artist's conception

The Lummus Company is designing a 200 million cubic foot/day gas conservation plant for Compania Shell de Venezuela on Lake Maracaibo near Laguinallas.

The new plant will reinject, at high pressures, gases which have been released during the production of crude.

The gas will be conducted from the gathering stations through a network of large pipelines, as large as 30" diameter, laid on the bottom of the lake to the reinjection plant. There, using local gas as fuel, the gas is compressed by 7 gas turbine driven compressors, having a total of 56,000 HP. The high pressure gas is then returned to the oil field by pipelines on the bottom of the lake.

The plant will be constructed on a 150' x 250' platform 15 feet above the lake level, supported by approximately 250 reinforced concrete piles. The plant's tropical architecture will conform to the styling of the locale and will include modern lockers, change rooms and canteen.

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VOL. 29, NO. 9 AUGUST, 1958

World Petroleum

THE MANAGEMENT PUBLICATION OF THE INTERNATIONAL PETROLEUM INDUSTRY

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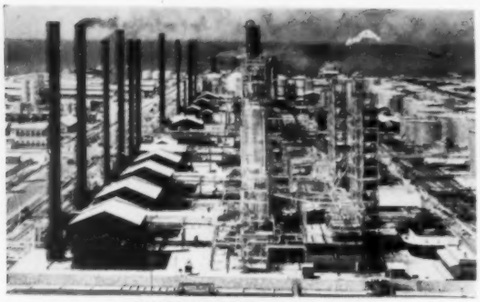
THIS MONTH'S COVER

"Rig at Willows" is a wood engraving by artist Paul Landacre commissioned by Arthur J. Heiser, general manager of Brown Drilling Co., Long Beach, Calif., and unveiled at a recent reception at the Los Angeles County Art Institute. The artist sought in his engraving to picture the elemental forces of wind, rain, mud, desert heat and mountain cold which man must endure in his search for oil. Brown Drilling will present a limited number of hand-pressed copies of the engraving to government and oil-industry leaders overseas. Brown now operates in France, Venezuela, and Turkey, and recently completed wells in Trinidad, Saudi Arabia, Australia, and Bahrain Island. Brown is owned by SOFINA, of Brussels, and interests represented by Lazard Frères & Co., Paris.



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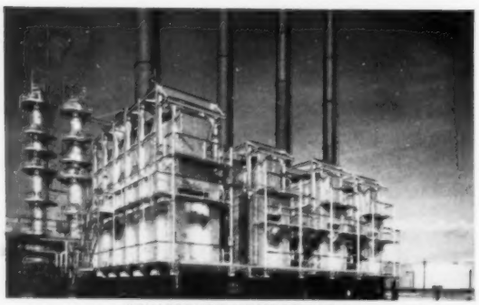

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CHICAGO, WASHINGTON, D. C., HOUSTON, MONTREAL, CARACAS, MARACAIBO, LONDON, PARIS, THE HAGUE

Washington

By Joseph B. Huttlinger

Since Iraq . . . .

Recent overthrow of government in Iraq launched Washington officials on series of moves on what to do in event Middle East oil, or significant part of it, is denied the Free World. Four of them are:

1. Military Petroleum Supply Agency asked oil companies for quick bid on supplying jet fuel and aviation gasoline for military bases in far-flung areas of the world. As usually, industry cooperated.

2. Military Sea Transportation Service called upon tanker operators to bid on supplying to government T-2's or equivalent on few weeks' notice—for Caribbean delivery. Quantity of tankers sought was not specified.

Interior Secretary Fred A. Seaton called a meeting in Washington, for July 23, of the Foreign Petroleum Supply Committee. Sixteen oil companies (entire membership of committee) were invited to give secretary advice on problems posed by Middle East situation. Secretary Seaton also named M. V. Carson, Jr., committee chairman. Captain Carson, director of Interior's Office of Oil and Gas, is administrator of voluntary oil-import program.

4. Captain Carson, meanwhile, has insisted events in Iraq "have no effect at the present time" on voluntary program to limit crude imports. In fact, he said, program will be needed for three to four more years—provided bulk of Middle East oil production continues flowing to Europe, which relies on that area for up to 80% of her oil needs.

Officials of some oil companies were reported planning to ask government for assurances there would be no antitrust crackdown similar to the one last May, after they had cooperated with government in the Suez crisis.

ODM Bars Aid to Pipelines

One of the last acts of Gordon Gray, as director of defense mobilization, was to rule against issuance of essentiality certificates for two long-pending pipeline projects which should have made them eligible for government loans or guarantees. They were the crude line proposed by West Coast Pipeline Co., Dallas, from West Texas to California, and the proposed prod-

Pipeline

ucts line from Beaumont, Texas, to Newark, N. J., proposed by American Pipe Line Co., headed by Paul Ryan, New York.

Such lines would be "desirable" for national defense but, with other lines constructed in recent years, they are not so "essential" as to warrant government aid, ODM Chief Gray ruled. He said this view was supported by reports from the Defense and Interior departments. (Gray moved up to the National Security Council, when Civil Defense Administrator Hoegh was named to head the new agency combining defense mobilization and civil defense.)

Oil Pipeline Tax Repealed

Congress voted to repeal the 4.5% tax on oil pipeline transportation after hearing appeals that it would be unfair to remove the 3% freight tax (railroad, trucks, and barges) and the non-tax on coal without providing similar relief for crude oil and petroleum products transported through pipelines.

Oil-Shale Program Shelved

Legislation for an ambitious program for oil-shale experimentation and research at Rifle, Colo., to be conducted by the Navy, has been shelved by the House Armed Services Committee for this session of Congress, at least. However, the Navy still has hopes of getting authority to lease out these facilities—formerly operated by the US Bureau of Mines—to private interests for oil-shale research. Meanwhile, the Navy's pipeline to utilize its natural-gas reserves at Point Barrow, Alaska, to heat government installations in that area is just about completed.

DJ May File Civil Suit

A long, drawn-out trial seems in prospect on the indictment, returned by a federal grand jury at Alexandria, Va., after an 18-month investigation. The indictment charged 29 oil companies with conspiring to raise prices of crude oil and motor gasoline in 1956-57. There was still the possibility that the Department of Justice, after analyzing the grand-jury data, might file a civil suit, too.

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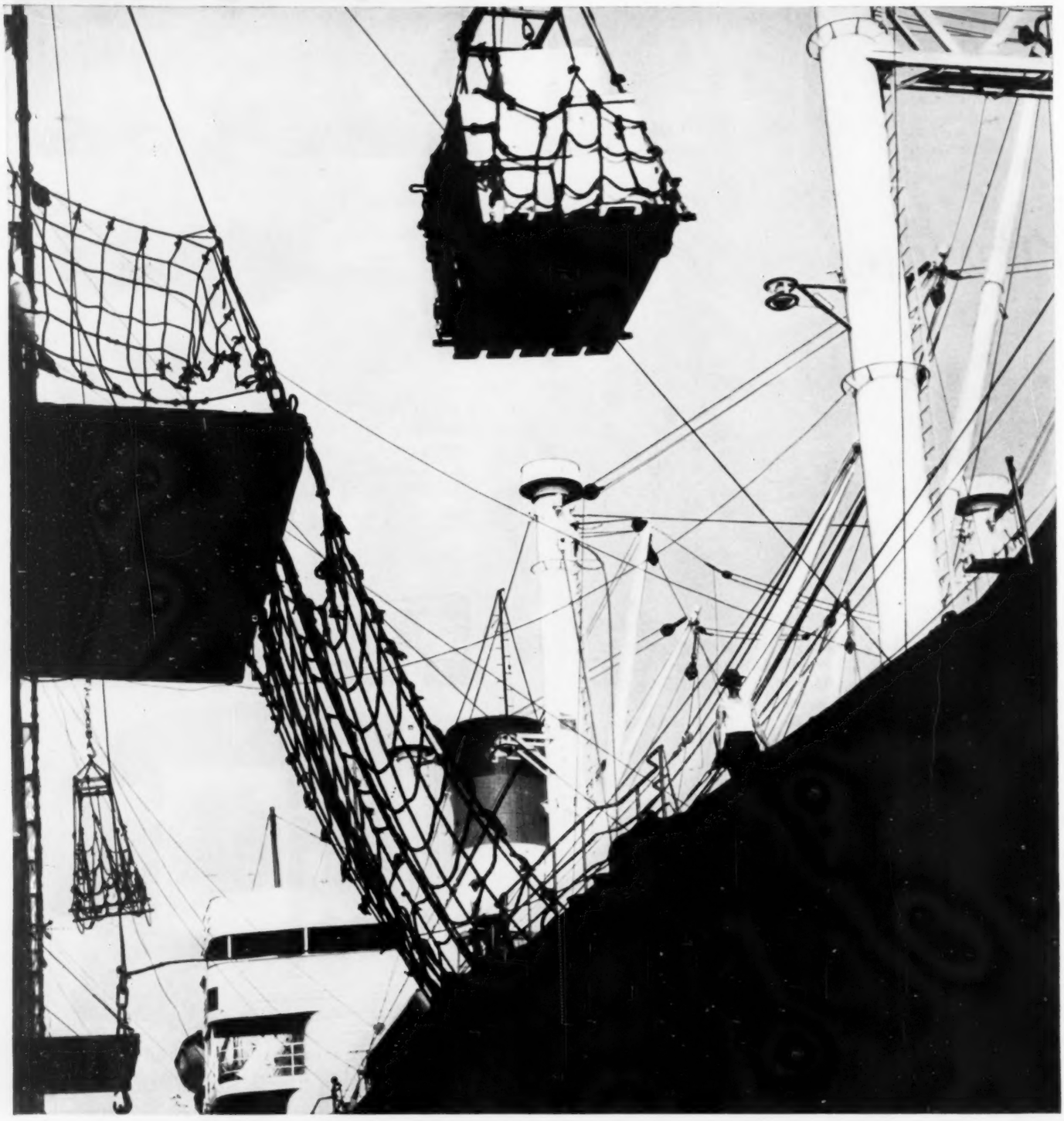

"The pace at which our neighbors' economic progress advances will determine—in increasing measure—our own rate of economic growth. Expanding trade in the free world is a must, and foreign oil is and will be a large factor in this activity."

M. J. Rathbone, President, Standard Oil Company (New Jersey)

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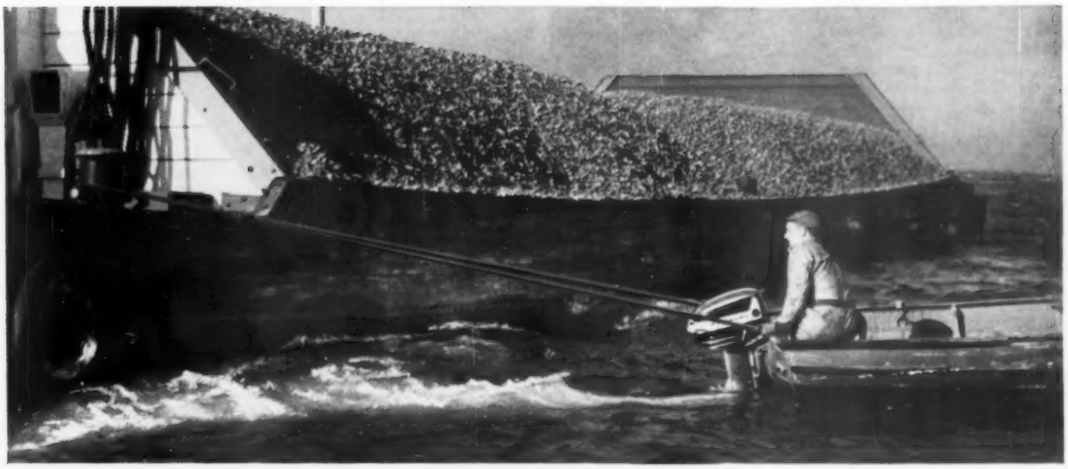

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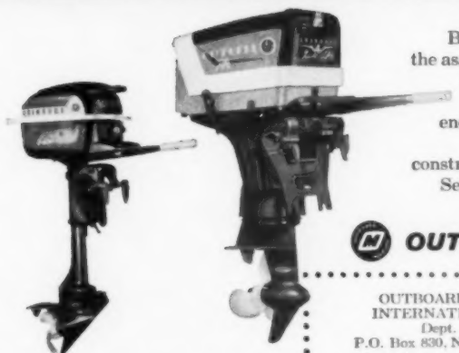

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CANADIAN NOTES

Trans-Canada Employs 3,000

3,000 men are working on the final 853-mile link of the Trans-Canada natural-gas pipeline from Alberta to eastern Canada. Total 1958 construction will be approximately $165 million. Completion is scheduled for the fall of this year.

Merit Acquires Clearfield

Merit Oil Ltd., Calgary, has acquired Clearfield Land Development Co. Ltd. The company stated that, through its acquisition of Clearfield, it has acquired interests in over four million acres of oil, gas, and mining properties in western Canada. Clifford R. Walker, founder and past president of Merrill Petroleum, is chairman. He also is vice president of Pacific Petroleum. Robert M. Ross, the founder and president of Clearfield, is president of Merit.

Exhibit For Canadian Oil

A Canadian petroleum industry exhibit created and shown by the Canadian Petroleum Assn. to exhibition and fair visitors in 20 western cities and towns during the past three years has been donated to The Oil Museum of Canada, at Oil Springs, the site of the first commercially successful oil well in North America. A collection of historical oil equipment and some examples of the industry in action today has been assembled in a modern building as a tribute to the oil industry's pioneers.

Gulf Islands Disappointing

An abandonment has marked the first effort by a five-company team to find oil or gas on Canada's Gulf Islands, B. C., but further drilling will be carried out in the area. The second well may be drilled to 8,000 ft. Saturna No. 1, at Lyal Harbor on Saturna Island, was abandoned at slightly under 4,000 ft. Site of the new well likely will be on Galiano Island or North Pender under present planning. Companies involved in the project are Charter Oil, Pacific Petroleums, Canadian Collieries, Imperial, and Standard.

Ottawa Office For CPA

Canadian Petroleum Assn. will establish an information office in Ottawa, as of September 1. William D. Stuart, currently executive assistant to General Manager John W. Proctor, will be manager of the Ottawa office. Mr. Stuart has been active in the petroleum industry for the past five years. Prior to his appointment as executive assistant, May 1, Mr. Stuart was statistician for the association in Calgary.

Leduc Gas Discovery

B. A.-Shell Berland River A-8 wildcat, located at LSD. 8-4-59-23-W5, is being completed as a Leduc gas discovery. The well opened a gross Leduc reef section of 663 ft, after encountering the Leduc top at 12,014 ft (8,513 ft below sea level).

During previous drill-stem tests, in the upper portion of the D-3, the well flowed gas at rates up to 27 million cubic feet per day.

This discovery is situated on a 400,000-acre reservation unit, owned jointly by British American and Shell Oil Co. of Canada. British American is operator.

Conference On Global Oil

Global developments in oil and gas will be under study in Montreal this September, as experts from 50 different nations gather for the World Power Conference. Meeting in Canada for the first time in its history, the conference will receive more than 20 papers dealing with petroleum and gas production, marketing, transportation, and utilization. Presenting them will be delegates from Canada, the United States, Russia, Great Britain, France, Austria, Switzerland, Romania, Sweden, Poland, and Indonesia.

Among those scheduled to present papers on the oil and gas phase of the meeting is M. E. Hubbard, of British Petroleum Co. Ltd., who will discuss the "Changing Pattern of Demand for Oil Products and its Effect on Refinery Output."

"Petroleum in Canada" will be examined by J. W. Flanagan, of Imperial Oil Ltd.

From the USA, C. C. Anderson, chief petroleum engineer of the Bureau of Mines, will discuss "Petroleum and Gas in the United States—Relation of Economic and Technological Trends."

Other experts from around the world will deal with such subjects as recent trends in the industrial utilization of gas, efficency of fuel utilization in Russian oil refineries, and power generation by large gas-turbine units in Sweden.

All told, some 150 papers will be presented to the Canadian meeting, to be held September 7-11 at The Queen Elizabeth, in Montreal, They will cover the production, transportation, and utilization of energy in all its aspects—hydraulic, thermal, nuclear, and even solar. Overall theme will be "Economic Trends in the Production, Transportation, and Utilization of Fuel and Energy."

Oil Springs Centennary Gift

The 100th anniversary, on June 27, of the discovery of oil in Canada, at Oil Springs, Ont., was highlighted by presentation to the town of Oil Springs of a scale replica of a spring-pole drill, earliest type of drilling apparatus used by oil pioneers in the Ontario oil fields. Presentation was by Canadian Oil Companies Ltd., and will remain in the little village as a permanent exhibit to visitors.

Canada's Gas Export Up

The discovery of gas in western Canada in the next 25 years should exceed an average rate of 4.4 trillion cubic feet per year, according to Alex Bailey, vice president of Baysel. Only in past year, he said, has there been any direct incentive to explore for gas, and present reserves of 27.8 trillion cubic feet have mostly been found incidentally to search for oil.

Pipeline Postponed

Indefinite postponement of hearings into an application by Mid-Continent Pipelines Ltd. to build a 1,500-mile crude-oil line from Edmonton to the USA-Saskatchewan border has been announced in Ottawa by the Board of Transport Commissioners. Hearings previously were scheduled fro June 17.

Berland Gas Find Large

The Berland River gas discovery well of British American and Shell yielded flow rate of 27 million cubic feet per day—said to be the largest flow ever recorded on drill-stem test in western Canada. An outpost of Devonian gas in northwestern Alberta, the discovery is rated one of the best in past 17 months, and indicates a probable major gas field.

40 MMMCF Gas For Inco

International Nickel Co. of Canada Ltd., largest nickel producer in the world, will convert a portion of its fuel requirements to natural gas this year, according to Ralph K. Farris, president of Northern Ontario Natural Gas Co. Ltd. Sales contract provides for delivery of 6 mmcf natural gas daily over a 20-year period to three Inco mills in the Sudbury area.

Canadian Company Data

THE FINANCIAL POST SURVEY OF OILS 1958 (CANADA), Vol. XVI, is a 250-page paper-covered review of Canadian oil and natural-gas companies, both active and inactive—plus oil and gas statistics and price ranges through 1957, and maps. This is the annual *Financial Post* review, and is available at $4.00 the copy from Maclean-Hunter Publishing Co., Ltd., 1242 Peel St., Montreal 2, or 481 University Ave., Toronto 2, Canada.

Personals

J. M. COURTRIGHT has been appointed eastern division manager of Shell Oil Co. of Canada Ltd., Toronto—succeeding P. L. Tremblay, deceased.

WILLIAM D. STUART, formerly statistician, has been appointed executive assistant to the general manager of Canadian Petroleum Assn., at Calgary, Alta. Replacing Mr. Stuart as statistician is James M. MacNicol.

J. F. KIDNER has been appointed treasurer of Canadian Oil Companies Ltd.—succeeding C. W. Walker, retired after 45 years' service. Associated with Canadian Oil for 27 years, Mr. Kidner previously was comptroller—which position he retains. His headquarters will continue at Toronto.

A. A. BROWN and **S. McGEHEE** have been appointed chief development geologist and staff supervisor—gas, respectively, for the California Standard Co., with headquarters in Calgary. Mr. Brown formerly was senior geologist—formation evaluation. Mr. McGehee was division gas engineer at Harvey, La.

FRANK MAIR has been appointed controller of Hudson's Bay Oil and Gas Co. Ltd., Calgary, succeeding F. F. SELLERS, who recently resigned. Mr. Mair formerly served as chief accountant.

C. J. CHRISTENSEN has been named division production superintendent for Pan American Petroleum Corp.'s Canadian division, with headquarters in Calgary, Alberta. He succeeds T. C. Borland, who has moved to New York as vice president—production and a director of Pan American International Oil Co., a wholly owned subsidiary of Pan American Petroleum.

Mr. Christensen comes to Calgary from Casper, Wyo., where since 1953 he has been assistant division production superintendent for Pan Am's Rocky Mountain division. Joining Pan American in 1934, he moved into engineering assignments in 1936.

FRANK M. JACOBSON, vice president of Murphy-Canada Oil Co., has been elected president and a director of Amurex Oil Co.; and **PAUL C. McDONALD,** vice president of Murphy Corp., has been elected an Amurex director. They succeed W. L. Falconer, former president and director, and Oliver H. Payne, former director, who have resigned.

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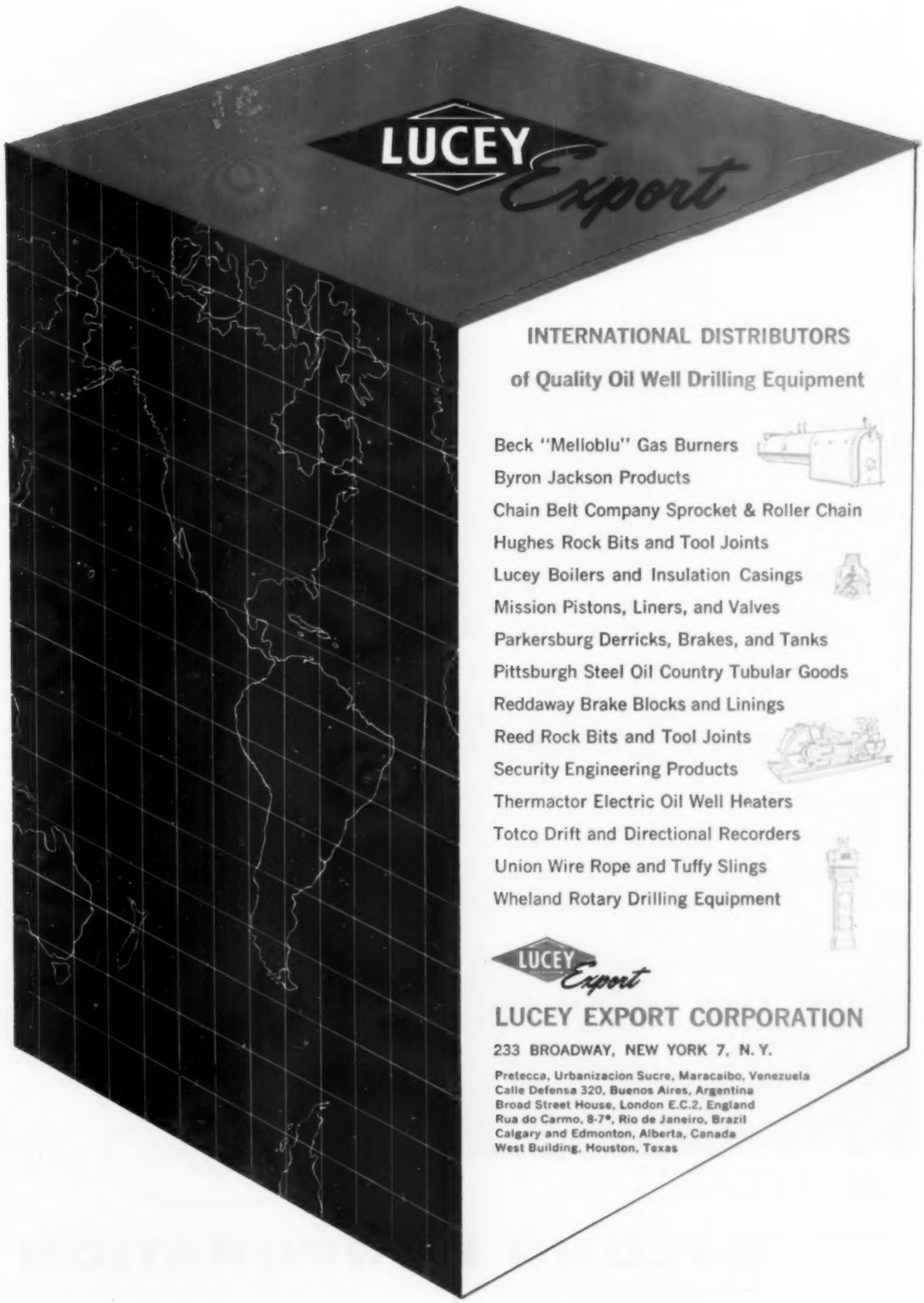

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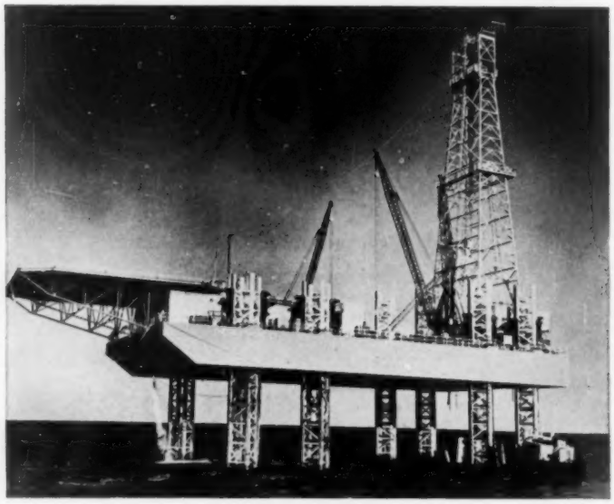
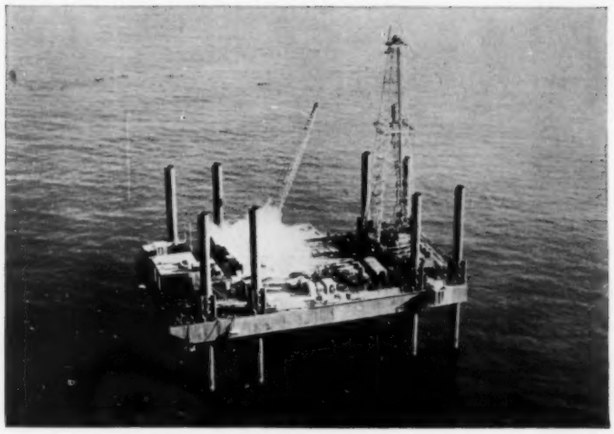
Now you can lease a **DeLong** mobile drilling platform for use worldwide

The fourth DeLong designed-and-built mobile drilling platform operating in the Gulf of Mexico. Owned by The Offshore Company.





The first mobile drilling platform operating in the Pacific — designed and built by DeLong. Owned by Offshore Constructors, a joint venture.

The first mobile offshore drilling platforms used in the Gulf of Mexico and off the coast of California were pioneered by DeLong Corporation. Soon DeLong units will be the first to operate in the Persian Gulf, off the coast of Trinidad, B.W.I., and offshore from Borneo.

These highly mobile, exceptionally efficient drilling platforms were designed by DeLong engineers, then fabricated for DeLong in United States or European shipyards.

Whether you wish to purchase an offshore drilling platform or lease one, contact DeLong. We will design it to meet your precise specifications. When construction is completed, the DeLong platform can be towed to any location in the world and, in several hours, raised into position by patented DeLong jacks. When the well has been drilled, the platform can be lowered to water and, after towing to the next well location to be drilled, jacked up to drilling position again all in a matter of hours.

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These peoples are resolved to build better lives for themselves and their children. And Stanvac will be there helping, all the way.

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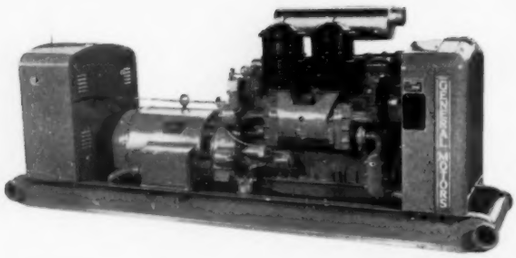
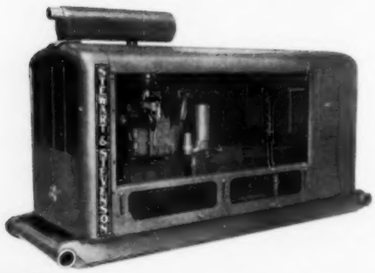


OPEN TYPE



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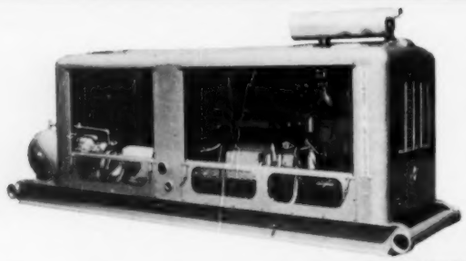

UTILITY UNIT

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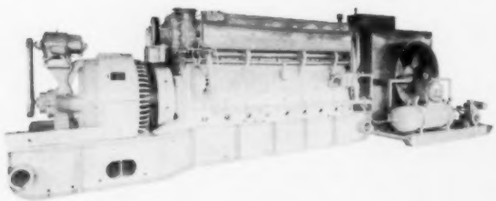
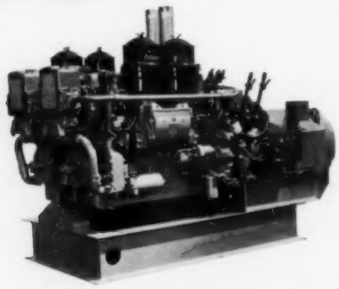


HEAT EXCHANGER TYPE



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Over centuries-old fields of rice and sugar cane a new sound is being heard ☆ Shouts of encouragement to plodding carabaos and oxen are being supplanted by the hum of modern farm machinery ☆ Efficient equipment is bringing in bigger crops with less effort—aiding economies, easing the farmer's life ☆ In many of the countries where agriculture plays a vital role, Caltex quality petroleum products help maintain and expand farm prosperity ☆ Through the power of petroleum, Caltex fuels and lubricants run the machinery that lightens the work load, increases the standard of living for the peoples of over 70 countries. Caltex—partner in progress in Europe, Africa, Asia, Australia and New Zealand.

CALTEX

PETROLEUM PRODUCTS

This all-new U-712-A drawworks, rated at 700-1200 net input horsepower, incorporates many outstanding features to increase drilling speed and efficiency. Manufactured by Unit Rig & Equipment Co., a subsidiary of Mid-Continent Supply Co., the U-712-A includes these important advantages:

- **NEW** Unitized controls, conveniently located in a single console, result in greater operational efficiency.
- **NEW** Grease lubrication of bearings with flood lubrication provided for chains, sprockets and splined clutches.
- **NEW** Self-equalizing 48" diameter brakes designed for rapid, drag-free release and smooth feed-off operation.
- **NEW** Fawick VC clutches mounted on the drum shaft for low and high drives, with an emergency splined clutch provided for the low drives.

The U-712-A is designed as an integral drilling unit which includes hoisting drum, transmission, rotary drive and auxiliary brake. For complete information, write for our U-712-A Bulletin or contact your local Mid-Continent representative.

DW3-8

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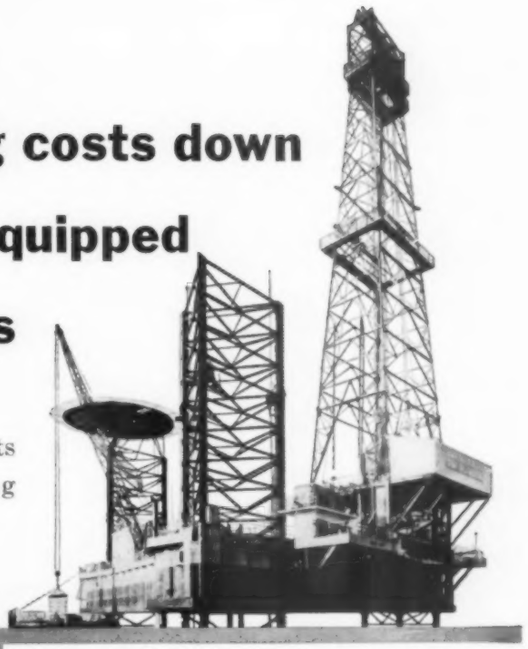
Keep your drilling costs down with Westinghouse-equipped *electric* rigs



Here are six ways you can lower operating costs and increase drilling efficiency by installing Westinghouse-equipped electric rigs:

FASTER RIG-UP . . . Unproductive rig-up time is reduced as much as 75% because there are fewer large, heavy units and no mechanical equipment to install or align.

EXTRA MOBILITY . . . Westinghouse equipment is compact and lightweight, suitable for skid-mounting. Each component is designed for easier, faster handling.

FASTER DRILLING . . . Instantly-responsive electric power provides quicker acceleration for faster pipe-handling and emergency pull-out.

REMOTE LOCATION . . . With no mechanical connections, the electric power plant may be located wherever convenient. In offshore drilling, this frees high-cost barge-deck areas.

FLEXIBLE CONTROL . . . Electrical control provides more flexible operation. Available power is quickly switched to any job — hoisting, pumping, rotating.

LESS MAINTENANCE . . . Electrical equipment eliminates problems of engine stalling and faulty clutches. With fewer working parts, repairs and shut-downs are reduced.

For an interesting booklet on Westinghouse products serving the oil industry, please write for booklet INT-7398 to Petroleum Sales Department, Westinghouse Electric International Company, 40 Wall St., New York 5, U. S. A.

Westinghouse manufactures a complete line of electrical equipment for every phase of the petroleum industry.

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Two String Penetration Successful with M-3 Gun, Ogival Bullets

McCullough M-3 Bullet Perforator Makes Good Well After Bullet Gun of Another Make Fails

After an unsuccessful attempt to get penetration by another service company, this Texas oil well was perforated by a McCullough M-3 Bullet Gun for a good producer.

Depth of operation was 5600'. A 5" OD 18 lb. liner had been cemented in 7⅝" OD 29.5 lb. casing which was cemented in open hole.

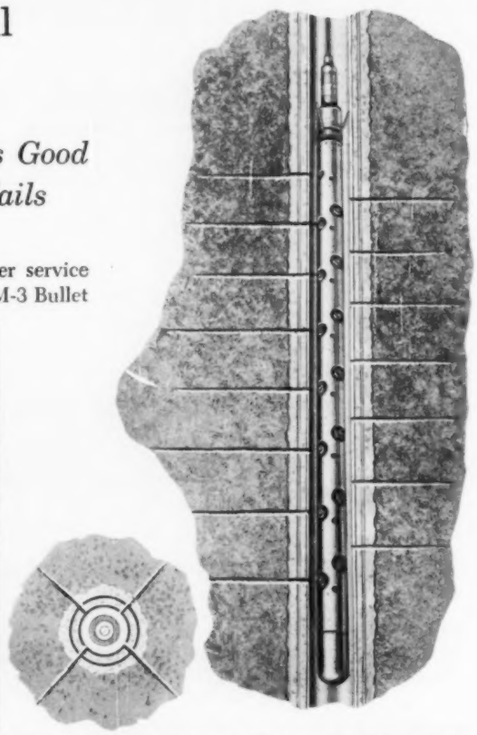
When first perforated by another make bullet gun, the well failed to respond. McCullough was called and a 3½" OD M-3 Bullet Gun fired 18 improved ½" Ogival Bullets, six per foot, in a three foot zone. Results—a good well and a very satisfied oil man. Time on the job was only two hours.

The greater penetrating power of McCullough M-3 Bullet Perforators has been proved time after time on jobs like this—penetrating two or even three strings of casing, through thick cement sheaths and deep into the producing formation—getting production or increasing production even after others have failed.

For most profitable perforating results—call for hard-shooting McCullough M-3 Bullet Guns.

The job described above is certified to be a true field report of service rendered.

Section of 5" OD casing, unrolled and laid flat to show uniformity of perforation pattern of McCullough M-3, 30-shot Bullet Gun—½" diameter holes, six shots per foot.



McCullough 30-shot M-3 Bullet Perforator. Fires all shots, one to six per foot, at one time. Three or more guns may be connected together and fired on one run.

UNIFORM PERFORATION PATTERN

... means a better oil well

One of the most valuable benefits of McCullough M-3 Bullet Perforating is the uniformity of the perforation pattern in the casing and formation. Shots are placed in a continuous spiral with uniform spacing, coinciding exactly with the pattern of the bullet chambers in the gun itself.

This permits the safe use of more holes per foot in the casing and eliminates the possibility of bunching or scattering the shots. It assures complete, uniform perforation coverage of the entire productive zone, provides maximum drainage area, best possible production.

The uniform perforation pattern combined with the fracturing power of McCullough Ogival Bullets at four to six shots per foot provides ideal conditions for further formation fracturing.

McCullough® *TOOL COMPANY*

Cable Address: MACTOOL

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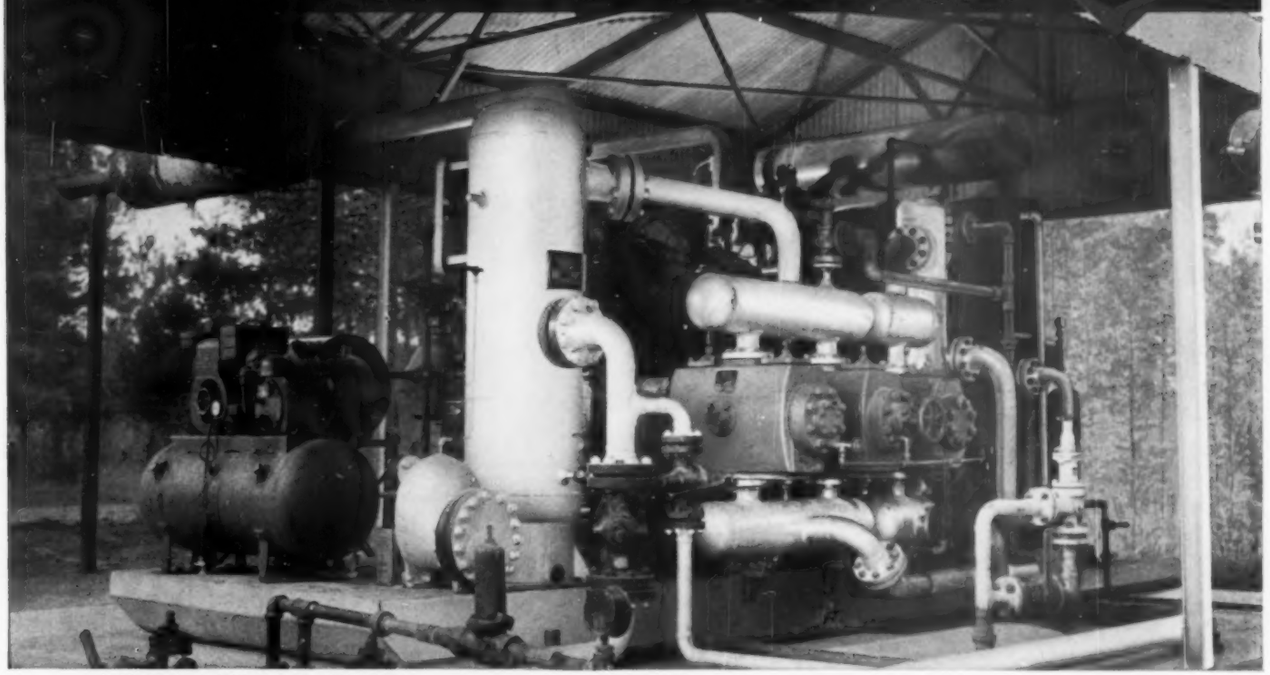
BEAIRD-INGERSOLL-RAND Packaged Compressor Plant

Lowest Cost Per Horsepower Installed



UNION PRODUCING COMPANY, ET AL. HULL STATION—equipped with a Beaird-Ingersoll-Rand 165 h.p. 6JVG Packaged Compressor. Unit has a Young Radiator with gas interstage, lubricating oil and engine cooling sections. Other Beaird compressors from 120 to 660 h.p.

Unit on Second Service—

FIELD CONVERSION FOR TWO STAGE OPERATION

Union Producing Company, et al., installed their Hull station in 1953 to boost gas in the Carthage Field. Consisting of one Beaird-Ingersoll-Rand 6JVG, 165-h.p. packaged compressor, the station handled 5.9 MMcfd with suction at 800 psig and discharge at 1300 psig.

During five years of production field pressures steadily declined until the original compressor could no longer operate efficiently. Rather than install a new unit it was determined that field conversion of the present compressor to two-stage operation would prove equally effective. This was quickly and economically done in the field. Two 7¼-inch cylinders were placed on the first compression stage and a 5-inch cylinder on the second stage. Interstage gas cooling was provided by adding a gas coil at the front of the existing radiator. A scrubber for the second stage was installed and clearance bottle connections were provided on all cylinders.

The unit is now back in operation handling 2.5 MMcfd with suction at 100 psig and discharge at 300 psig. This field conversion will enable the unit to operate fully loaded down through final production of the field.

Beaird's gas engineers are experienced in finding economical solutions to every type of production problem . . . call us today.

THE J. B. BEAIRD COMPANY, INC.
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BEAIRD another AMF product PACKAGED COMPRESSOR PLANTS

Packaged Compressors are just one of the many products manufactured by Beaird for the petroleum and petrochemical industries. When you are in the market for new equipment or assistance in developing a specialized product . . . contact Beaird for a qualified appraisal or quotation.

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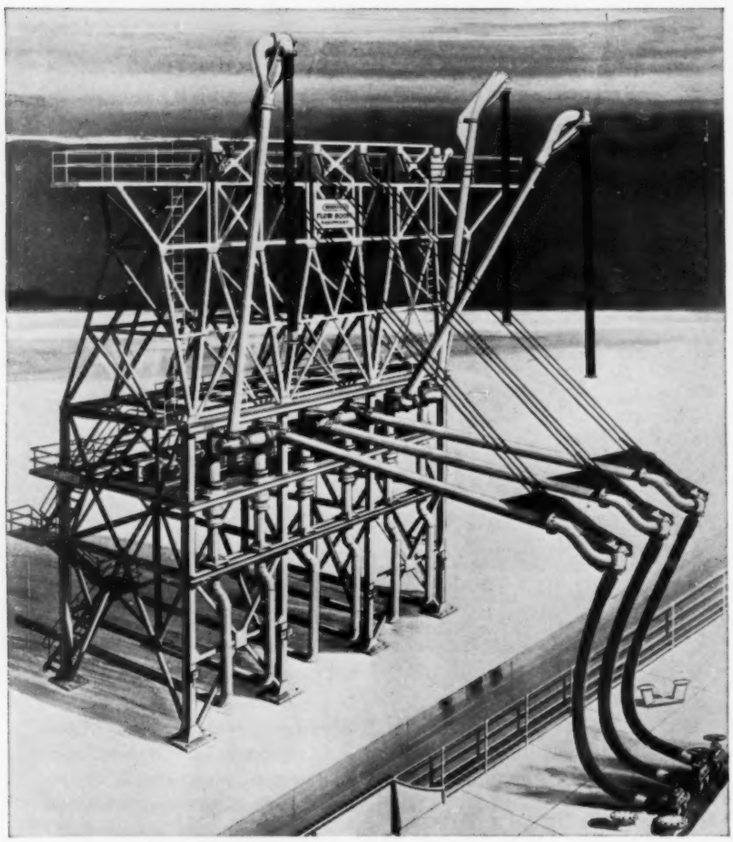
WOODFIELD FLOW BOOM EQUIPMENT

loads and unloads Tankers from 2,000 to 100,000 tons capacity

and allows for manifold rise and fall of 75ft.



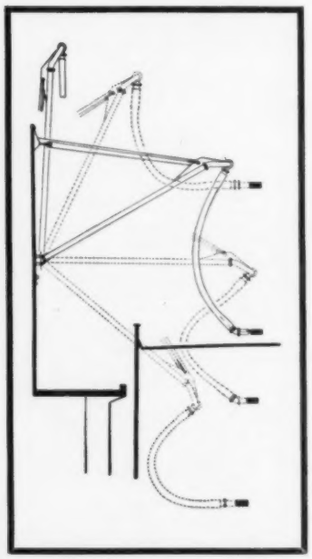


Diagram showing luffing motion of Flow Boom. This system can be designed to accommodate tankers ranging from 2,000 to 100,000 tons, and to suit local berthing conditions anywhere in the world.

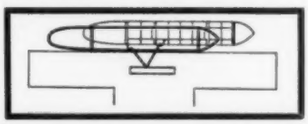


Diagram illustrating manner in which free slewing of Flow Boom permits safe tanker drift.

Woodfield Flow Boom Equipment features these vital advantages:—

- ★ **Slewing arcs in excess of 120° allow wide tolerances in tanker spotting and drift.**
- ★ **With this equipment tanker manifold heights may vary by 75 ft.: subject to sizes of tankers handled and local tide conditions.**
- ★ **Boomhead Swivel, exclusive Woodfield development ensures minimum restraint and maximum life of hoses.**
- ★ **Standard Boom lengths 30 ft. and 40 ft.**
- ★ **King Posts: Exclusive Woodfield feature, including Woodfield Joints.**
- ★ **Use of flexible hose kept to minimum.**
- ★ **Boom sizes: 8″, 10″, 12″ and 16″ nominal bore.**
- ★ **Structure: Designed individually to meet site requirements.**
- ★ **Control: Pneumatic, Hydraulic or electric operation reduces operator technique to minimum. Dual push-button control at upper deck and jetty level requires minimum supervision and effort.**

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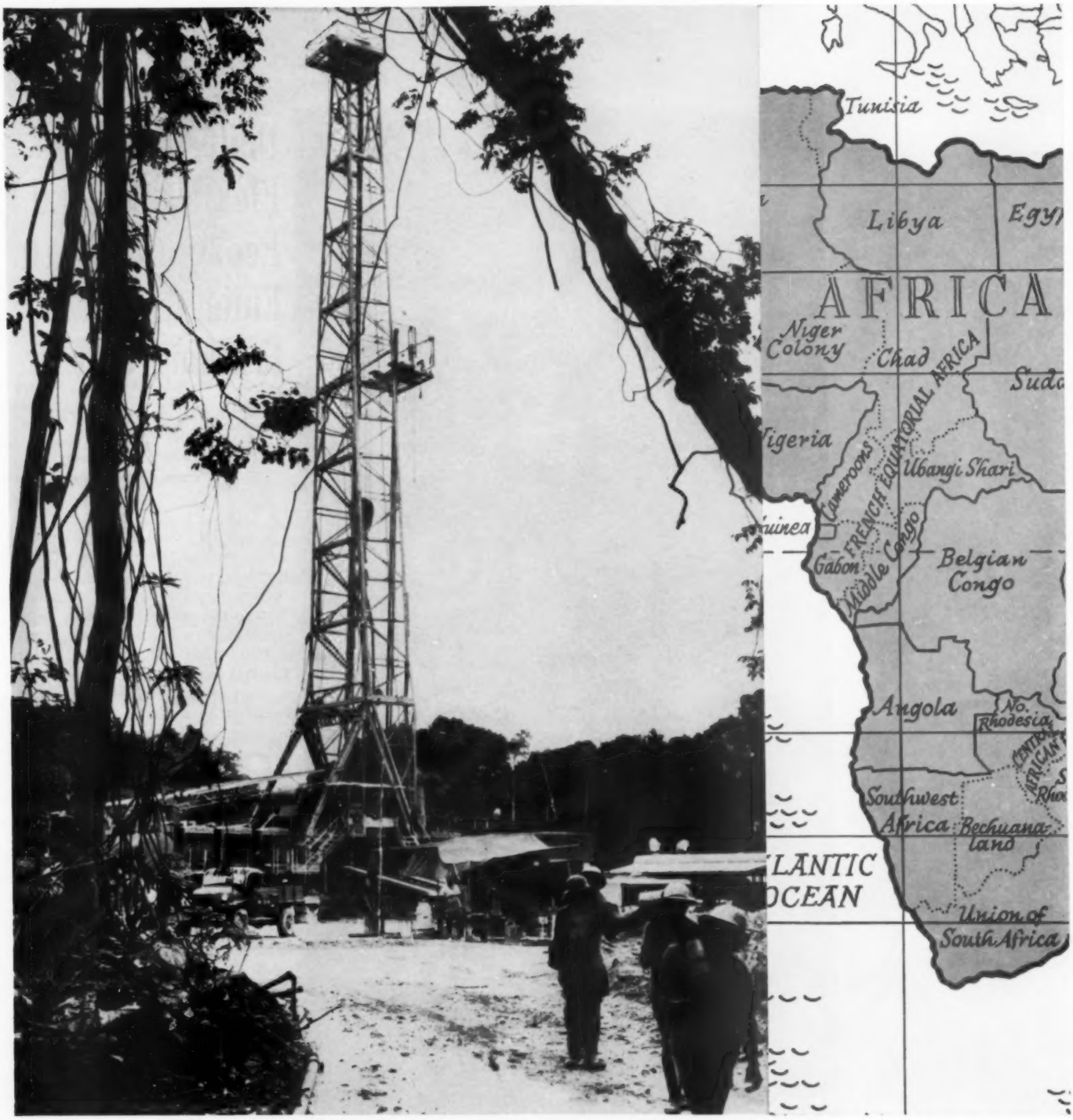

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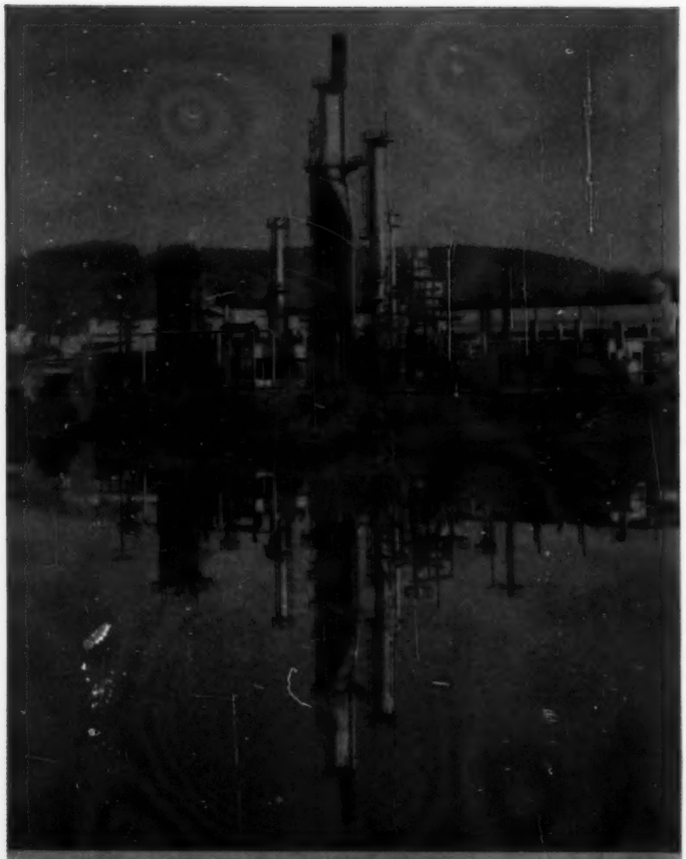


United Refining Company's cat cracker casts an interesting reflection in the waters of the famous Allegheny River at Warren, Pennsylvania.

UOP Cat Cracker helps United increase gasoline yield up to 50% and reduces lower value middle distillates

UOP UNIVERSAL OIL PRODUCTS COMPANY
30 Algonquin Road, Des Plaines, Illinois, U.S.A.

More Than Forty Years Of Leadership In Petroleum Refining Technology

United Improves Flexibility And Economics With Fluid Catalytic Cracking Unit

by H. A. Logan Jr.,
President
United Refining Company
Warren, Pennsylvania

On June 23, 1957, United Refining Company completed 55 years in the refining of petroleum products. As auspicious as this occasion may have been, we did not celebrate in the usual sense. Rather, we concerned ourselves with future plans, in which a 2,500 BPSD UOP Fluid Catalytic Cracking unit, on stream May 5, 1957, has a significant part. Indeed, it is a happy feeling for us at United to know that we are going into our 57th year so well equipped for continuing our tradition of service to our customers by providing top quality petroleum products.

Cat Cracker proves best

Early in 1956, we approached Universal Oil Products Company, licensor of petroleum refining processes, for assistance in planning our modernization program. Because of our particular need, UOP suggested the Fluid Catalytic Cracking unit. But before making a final selection, we organized a thorough and complete study of the problem, including all available alternatives, to determine the process that would both allow us to best serve the needs of our customers with high-quality products, and to do so at reasonable initial investment and operating costs. As a result of this study, we found that the UOP Cat Cracker was the most satisfactory choice for us because the process afforded United a greater flexibility in charge stocks, better quality of products, and lower investment costs. With the addition of the UOP Fluid Catalytic Cracking unit, our refinery is equipped to process a much larger volume of Mid-Continent crude, which will account for the major proportion

H. A. Logan Jr.

of our light products. Thus, we now have a much broader base of operations, a greater flexibility, and a more favorable economic position than before.

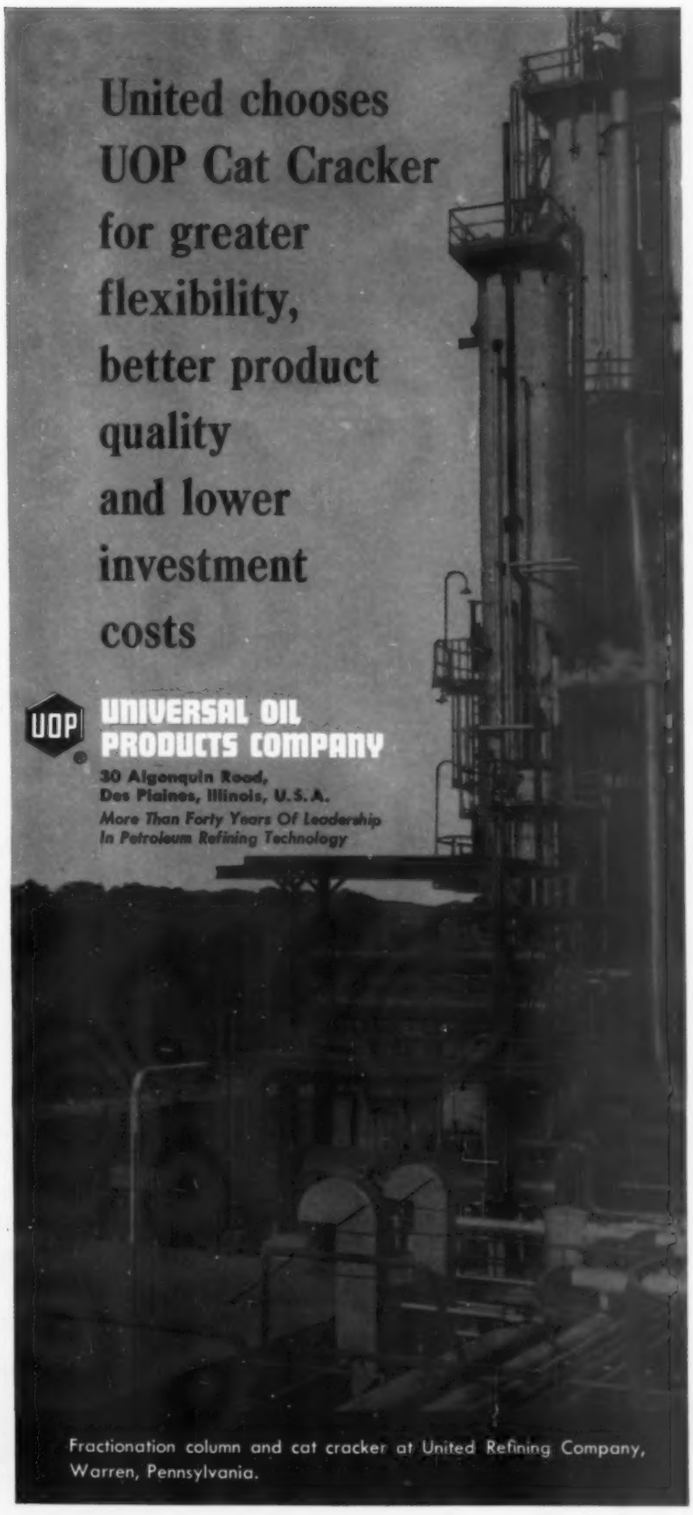
30% to 50% yield increase

As is true with other refiners, we are vitally concerned with yield. Since the UOP Fluid Catalytic Cracking unit was placed on stream, our gasoline yield has increased from 30% to 50% with a corresponding reduction in the production of lower value middle distillates. The cat cracker has provided us with a greatly improved octane potential. Today we are marketing premium and regular gasolines with octane ratings which rank among the highest in the country. As a plus feature, the UOP Fluid Catalytic Cracking unit has given us an improved realization for the middle of the barrel. We are producing one new product from the cat cracker, LPG, that we have not previously marketed.

After several months of operation, I can say that our original assumptions in the selection of the UOP Cat Cracker have been justified. Since our start-up we have consistently operated at design capacity or above, and our yields have been better than UOP's estimates.

For the future . . .

Our 55th anniversary came at a time when, undoubtedly, more is expected from petroleum products than at any other year in our history. Over the years, we have developed a reputation for product quality which we have maintained through the application of the very latest refining technology. At United we use to maximum advantage both the processing know-how of our many years in the refinery business and the technology researched, developed, and made available to us by refinery specialists such as Universal Oil Products Company. In the future we will continue to operate in this tradition.



Fractionation column and cat cracker at United Refining Company, Warren, Pennsylvania.

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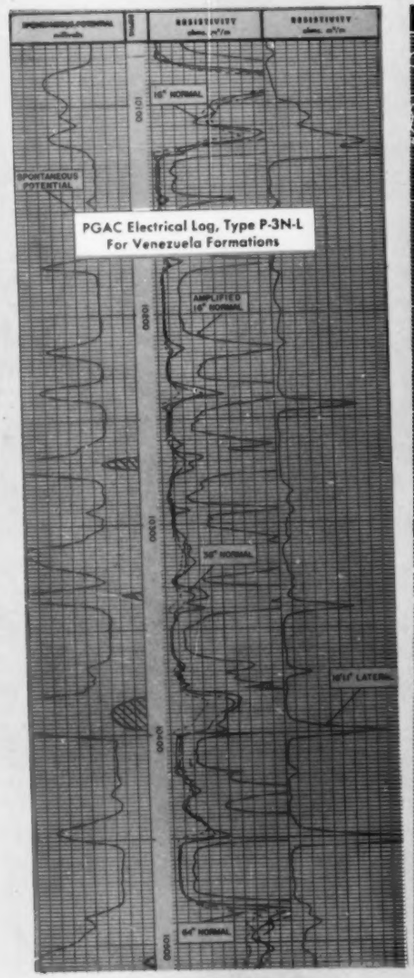

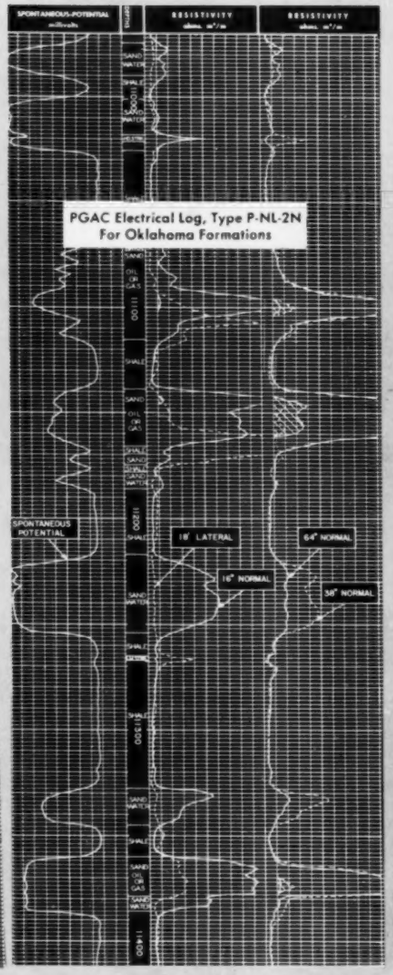

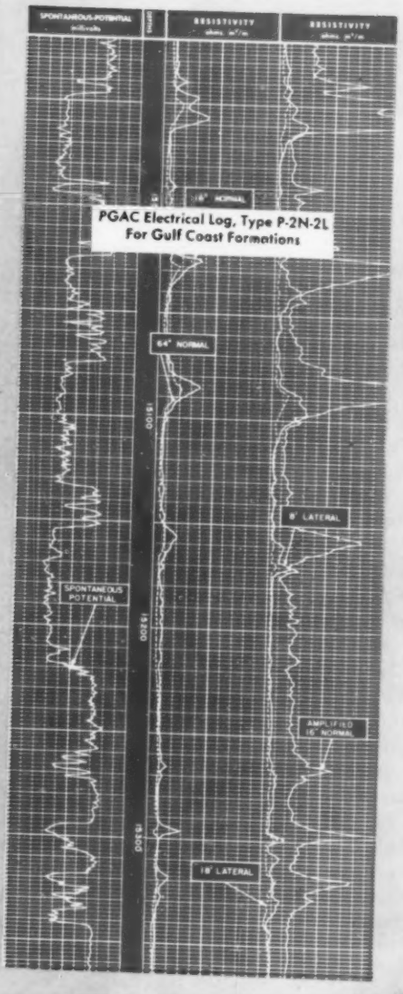

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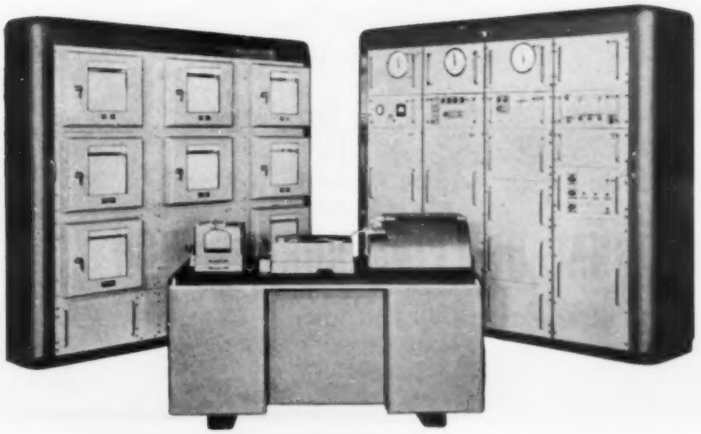

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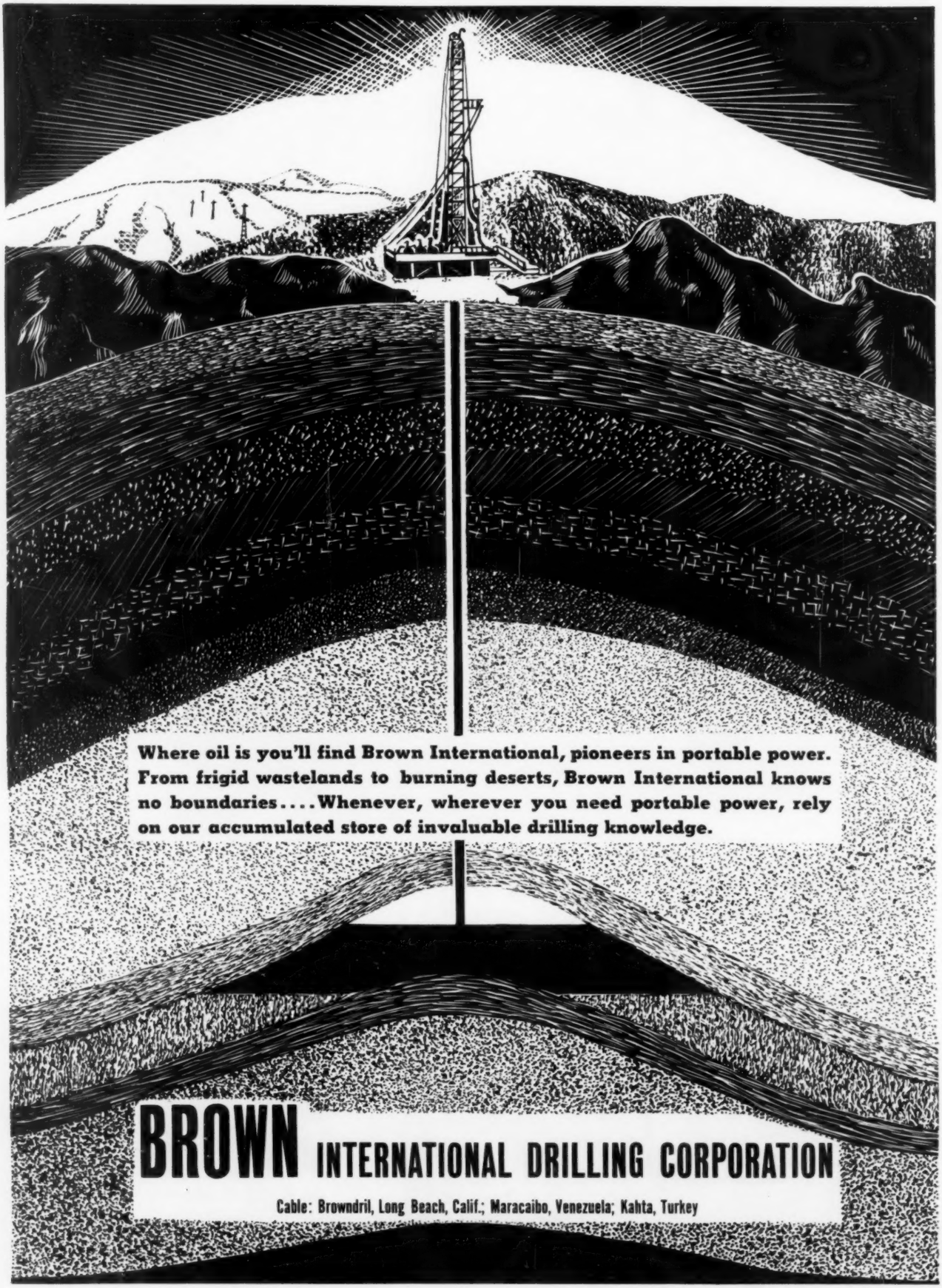
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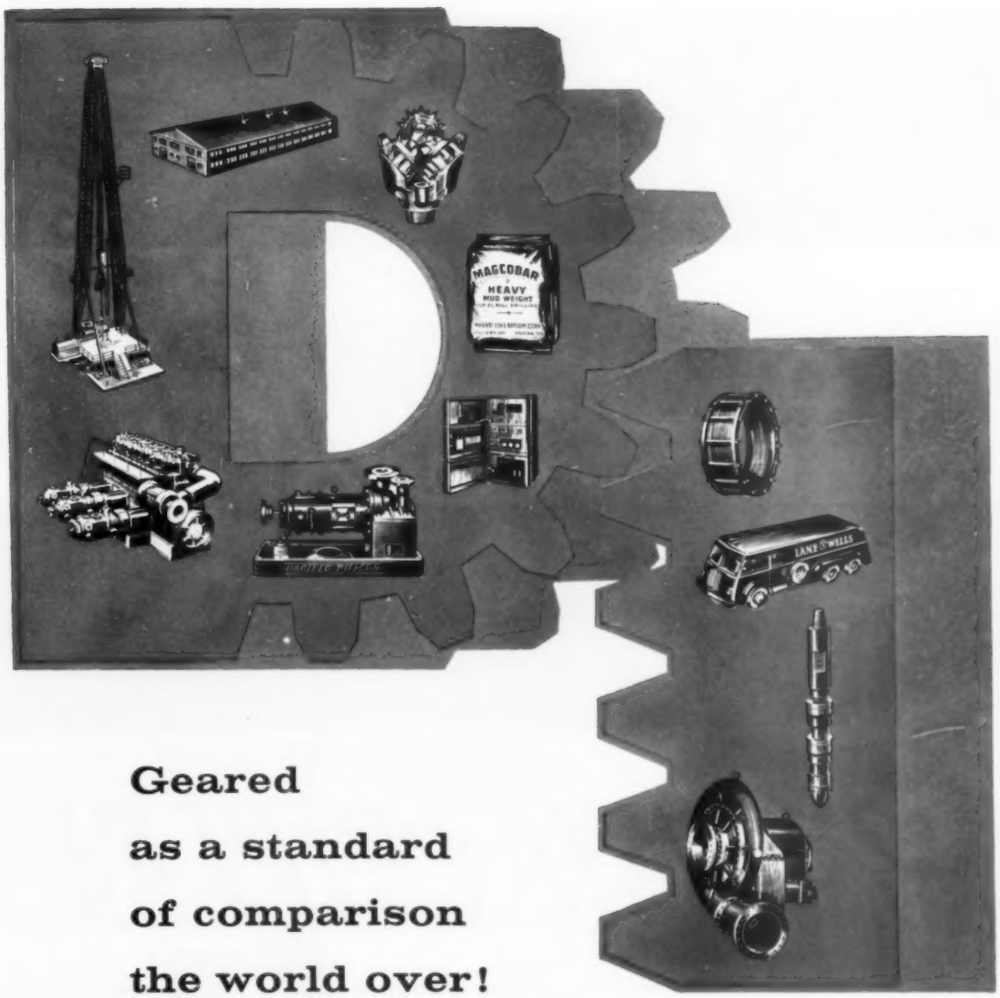

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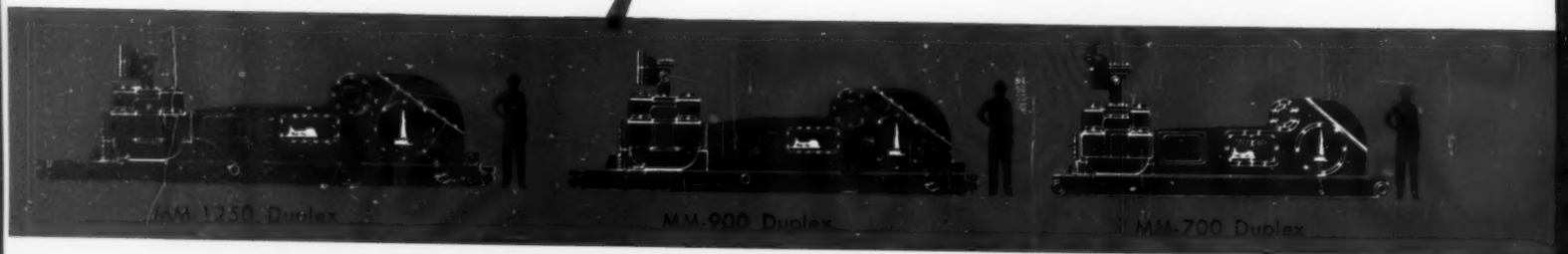

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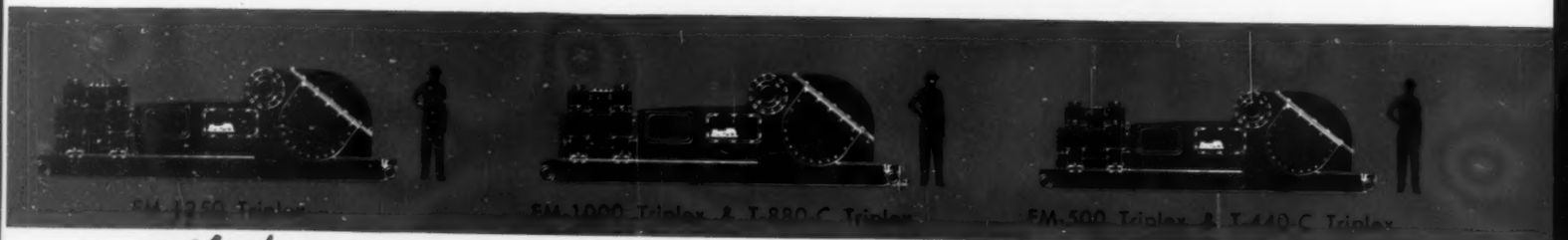

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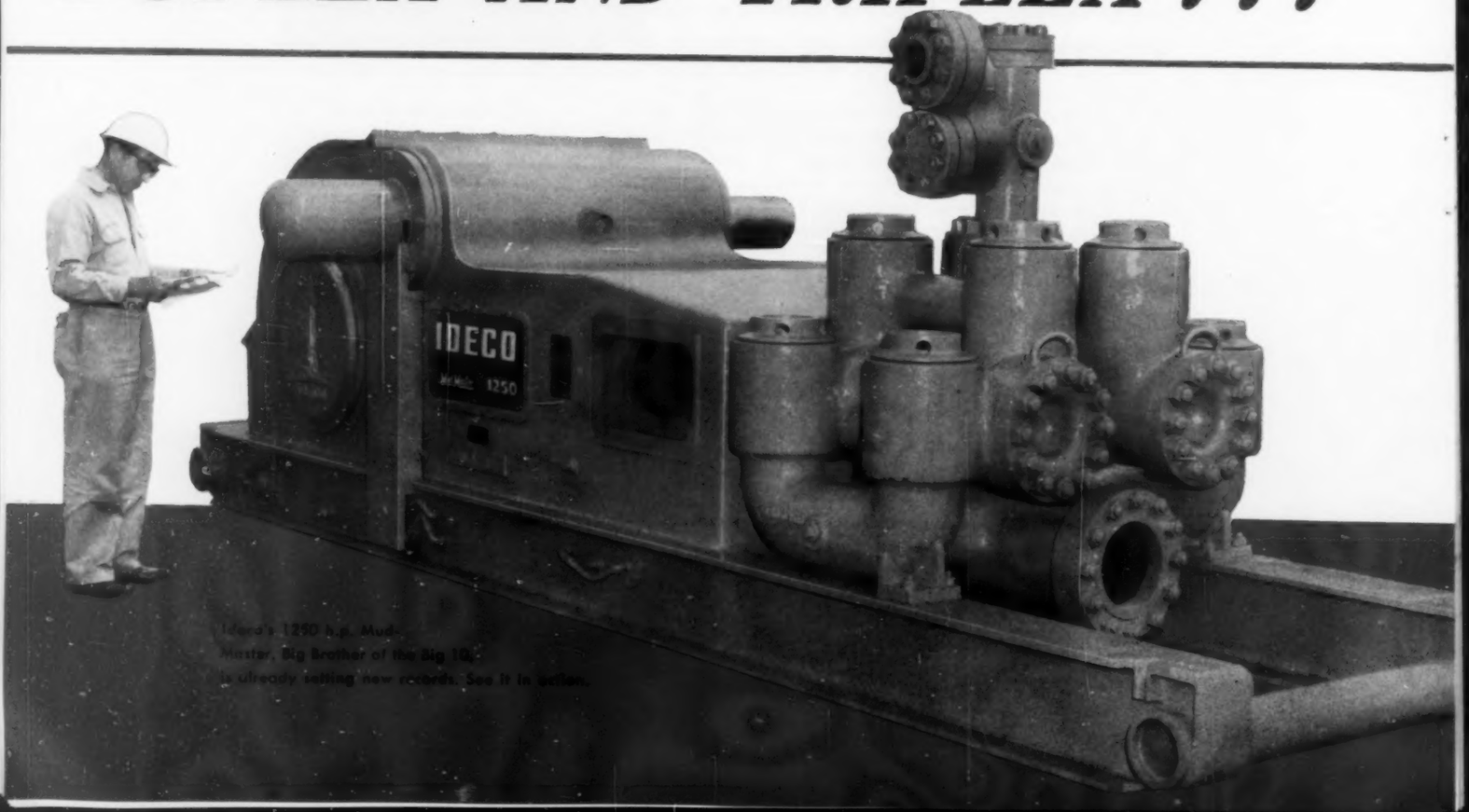

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P.1418

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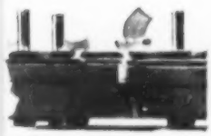

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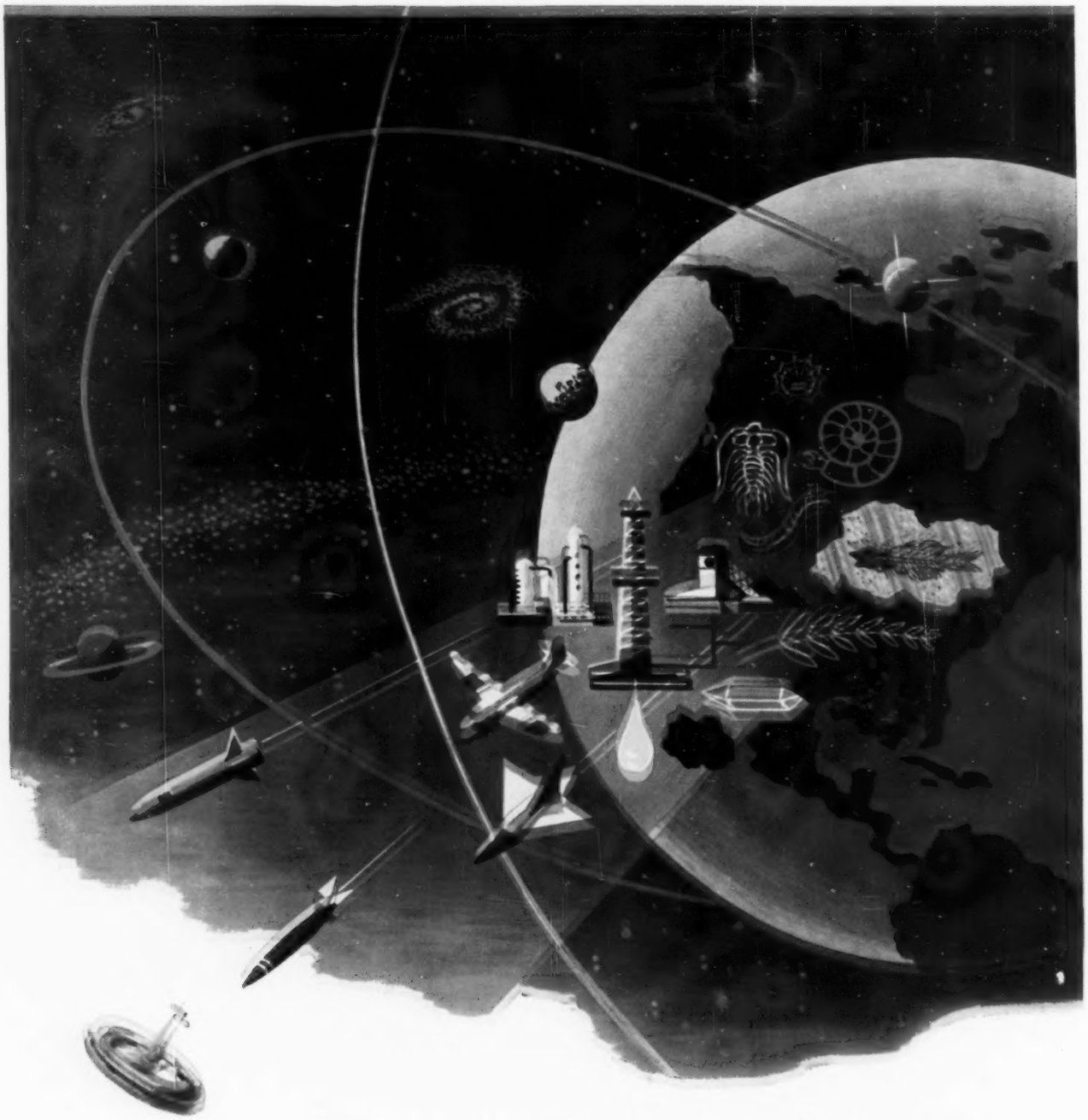

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The High Cost of Dry Holes

DIFFICULTIES in which the domestic oil producer in the United States now finds himself are strikingly portrayed in an article in a recent issue of *The Humble Way*, house magazine of Humble Oil & Refining Co. Titled "The High Cost of Dry Holes," the article shows that 20 years ago 10% of the company's annual drilling expense went into dry holes. At that time, only 10% of the total wells drilled were dry. In 1957, dry holes cost Humble 42% of the drilling dollar, and 26% of all wells drilled were dry.

One difficulty of the industry is that new production is being found in smaller and deeper pools. This means the drilling cost mounts at an accelerated rate. Humble shows that an 8,000-ft well costs $14 per foot, while a 15,000-ft well costs $35. A Louisiana deep record well was drilled to 22,570 ft at $110 per foot.

All elements making up the cost of drilling are higher. In the past 10 years tubular goods and labor have risen 56%; drilling equipment is up 60%; cement, muds, and well services cost twice as much as a decade ago.

Last year, the industry spent a billion dollars for dry holes. This is about 40 cents for every barrel of oil produced. Half of all the money spent on exploration and drilling results in no production.

Unfortunately, the price of oil has not kept pace with costs. As the Humble article expresses the situation, "The rising costs of finding and producing oil have far outdistanced oil price increases. Leading oil explorers are warning that, under present trends, the cost of finding USA oil may soon equal the value of the oil."

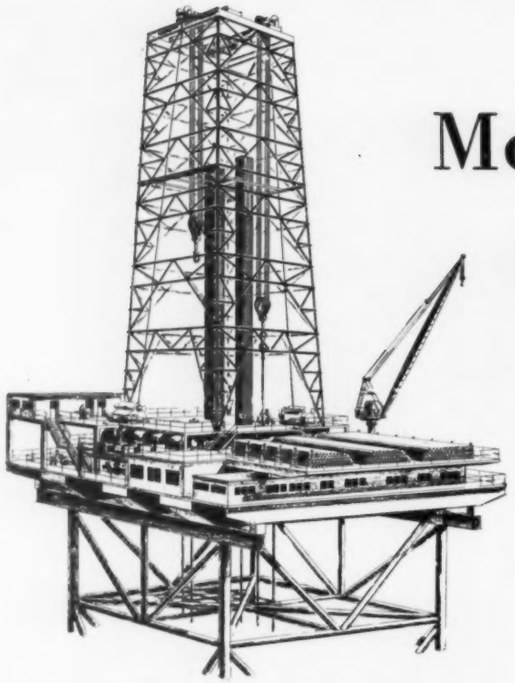
There are a number of restraints acting on the oil market which retard higher levels in line with higher costs. Industrial fuel oil must compete with coal and, to a lesser extent, with natural gas as a source of energy. Domestic fuel oil is in direct competition with gas in a growing part of the market. The oil man is, in effect, competing with himself. In the case of his gas sales, his price levels are low because of government restrictions. Coal still cannot be ignored in this field.

Domestic crude oil also is in competition with surplus foreign crude. The price level in the USA cannot be too far above the world level even under "voluntary" import restrictions. To attempt an adequately compensatory domestic market without regard to foreign competition soon would create political pressures in predominantly consuming areas.

The Humble article suggests a number of expedients in controlling drilling costs. For one—"Today's knowledge of reservoir behavior is so great . . . that wider spacing would allow for proper drainage of oil and at the same time make domestic producers more competitive in the worldwide petroleum industry." Another, of course, is greater selectivity in choosing drill sites for wildcats.

For the future, Humble suggests that ultra slim-hole drilling will have greater emphasis in the next 10 years. "Reducing a hole from seven to two inches will result in tremendous steel savings in some wells," the article stated.

The petroleum industry is aided in its search for lower costs by an alert and highly competitive equipment industry which has contributed greatly to the efficiency of finding and lifting oil. Elsewhere in this issue are a number of reports on developments in this field—a slim-hole well put on production without casing, instrument controls for efficient drilling, research into new drilling methods, new low-cost wellhead assemblies, research and development of better sucker rods. The oil producer is fortunate in having such an efficient partner in his search for oil in an inflationary economy.



Offshore platform recently towed to a site near Summerland, Calif. for Standard Oil Co. of California and Humble Oil & Refining Co.: The platform is designed to drill two holes simultaneously, and will be capable of drilling 25 wells without a move. The deck is 110 ft square, and has a clearance of 50 ft above the ocean. The tower is 75 ft square and 170 ft high. The unit was built by National Steel & Shipbuilding Co., of San Diego, and towed to its location on caissons, filled with 6,000 tons of sand and concrete ballast when sunk and jetted in.

More orderly procedures mark offshore drilling

by James W. Calvert

Without any revolutionary development in equipment, drilling costs have been cut up to 35% by increasing weight on bits, increasing drill-collar diameters, adding stabilizers, decreasing mud weights. Drilling time has been cut nearly in half.

After five tumultuous years of some of the most expensive prospecting in history, the oil industry has taken advantage of national economic decline for a reappraisal of the controversial "tidelands" oil and gas fields of the Gulf of Mexico.

From its peak operation of some 160 rigs in mid-1957, the industry is now operating about 60 drilling rigs in the offshore areas off the coasts of Louisiana and Texas; and hundreds of vessels of all types—submersible drilling barges, crew boats, work barges, tugs—are idle for the first time since President Eisenhower signed the Submerged Lands Act in 1953 and thus dropped the "go" signal in the race for rich offshore leases. So are many Gulf Coast shipyards which, in recent years, have been frantically turning out the millions of dollars worth of sea-going oil-drilling equipment.

"It looks like the boom is over," remarked one oil-company executive, who expressed the belief—and the hope—that the offshore development would now proceed in a more orderly and less expensive manner.

The five-year period just ended has witnessed unparalleled spending in the search for oil and gas reserves. Conservatively, the output has been estimated at well in excess of $2 billion, or just about equal the amount paid to state and federal governments in the form of lease bonuses, rentals, and royalties.

The gulf "tidelands," or submerged lands off the Texas and Louisiana coasts, are so vast that only vague estimates have been made of the potential petroleum resources lying underneath the treacherous waters of the Gulf of Mexico.

The word "tidelands" is really a misnomer, in the technical sense that a tideland is a narrow strip of land over which tidal waters ebb and flow. The word has become synonymous with the expanse of land extending to the rim of the continental shelf. Geologists have consistently contended that the offshore area is actually a continuation of the onshore fields, with rich sediments of the Miocene and Oligocene ages which have characterized the adjacent land; that the offshore potential, therefore, should be as great—or even greater—than the proved adjacent onshore areas.

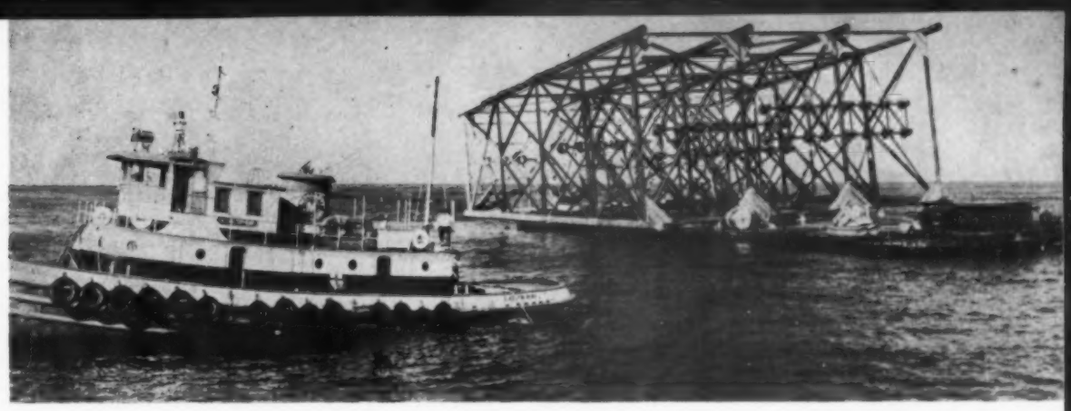
The onshore fields extend from the Mississippi delta to the Rio Grande River—approximately 700 miles wide and about 50 miles in depth. Exploration has been active in an area covering 52,500 square miles, to an average depth of 8,300 ft. As of January 1, 1957, this area had proved reserves of 135 trillion cubic feet of gas and 20 million barrels of oil and other liquid hydrocarbons—with withdrawals totaling 33 trillion cubic feet of natural gas and 9.5 billion barrels of hydrocarbons.

Offshore, the submerged fields conceivably extend to the edge of the continental shelf, or 100-fathom curve (600 ft). The continental shelf is about 11 miles wide at the mouth of the Mississippi River, and about 132 miles wide at the mouth of the Sabine River.

For practical purposes, however—inasmuch as few wells have yet been drilled farther than 50 miles at sea—the geologists consider the offshore area, for purposes of potential reserve estimates, to equal in size the onshore area. As Bouwe Dykstra, vice president of Shell Oil Co., explains: "It seems reasonable to expect some relationship between surface area and ultimate production as long as the geologic conditions are similar.

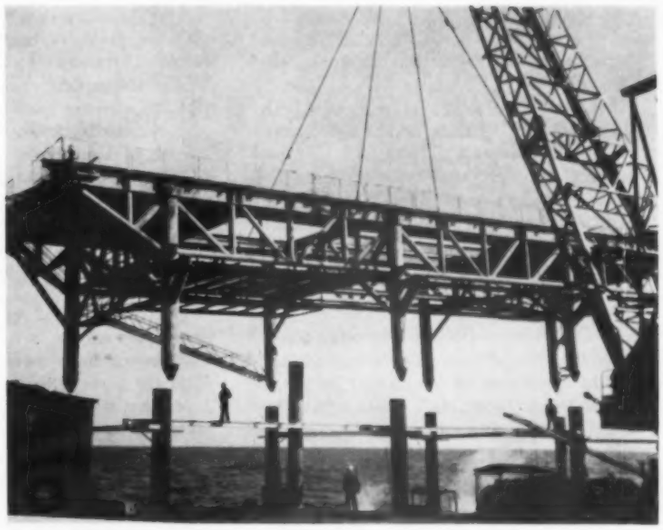
"We know that the coast line does not represent a break in the crust of the earth, or at least not here in Louisiana; and we know that on both sides of the coast line there are many known salt domes. So geologic conditions on both sides of the coast line are similar."

Some geologists believe offshore sediments are better than those found in ad-



Foundation structure for the permanent platform for Gulf Oil Corp.'s well in the South Timbalier area is towed into place. This also set a new record—a well drilled in the deepest water from a permanent structure. The depth was 136 ft. The launching barge is 240 ft long—which gives some idea of the size of the structure.

Built by McDermott Fabricators, the huge structure "goes overboard" on location. The launching barge was designed by H. W. Bailey, manager of McDermott Fabricators. On location, the barge is flooded at one end; and the structure literally slides down the ways, where it is easily rotated into place by J. Ray McDermott's derrick barge No. 7.



After steel piling has been driven through the templet jackets and 175 ft into the floor of the ocean, the drilling platform is set into place by derrick barge No. 7. This platform weights 250 tons.

jacent areas onshore, and that the indicated reserves in the 700- by 50-mile area offshore might be as much as 30 billion barrels of oil and 240 trillion cubic feet of gas.

Mr. Dykstra takes a more conservative view:

"Considering that the onshore has been more intensively developed than the continental shelf," he says, "and also keeping in mind that the offshore development should go beyond the 100-ft depth contour, I would say that it seems reasonable to set as a target for the industry to find offshore six billion barrels of oil and 40 trillion cubic feet of gas. I use the word 'target' advisedly because there may be much more oil and gas offshore, but certainly it is not in sight."

Actually, no oil or gas fields have been completely outlined or delineated; therefore, it is far too early to estimate accurately the petroleum potential of the gulf "tidelands." Proved offshore reserves to date total 800 million barrels of oil and five trillion cubic feet of gas.

"So up to this time the industry has not done too badly," continues Mr. Dykstra, "considering that it gained also a tremendous amount of knowledge of the geology and operating conditions offshore. This achievement came about by working offshore 10 years after the end of the war.

"To meet the target I just mentioned, say in 10 years, the industry will have to be six or seven times as successful in the next 10 years as it has been in the past. It seems a tremendous assignment; yet I believe, under the proper economic incentives, it can be done."

He reminds that offshore drilling technique is only an extension of the techniques used onshore in the marshes.

"The mobile barges and mobile platforms are a broader application of the principles used in the marsh rigs; the self-contained platforms and tender-type platforms are a broader application of the pile-driven well installations we used in the swamps before the drilling barge made that method unattractive. In other words, we have not yet developed a drilling technique for the offshore which brings within reach the oil and gas reserves hidden under the outerparts of the continental shelf.

"The target for the industry of finding six billion barrels of oil and 40 trillion cubic feet of gas should include the obligation to find better means and better methods of drilling and producing wells in water of greater depth."

Since Kerr-McGee Industries Inc. brought in the first commercial well in Block 32 of the Ship Shoal area of Louisiana, 11 miles from land, some 2,000 wells have been drilled in the offshore areas of Louisiana and Texas—1,157 of them in 1956 and 1957. Last year a total of 680 offshore wells was drilled, of which 648 were off the Louisiana coast and 32 in the Texas submerged lands.

Drilling slacked off during the last quarter of 1957 and the first quarter of 1958, but it was still ahead of the national decline of 7% in the same period.

The Louisiana State Department of Conservation recently compiled cumulative production figures for its offshore fields, by zones—reporting 160,006,848 bbl of crude oil have been produced from offshore wells through 1957. There was also a total production of 2,158,872 bbl of condensate, 134,714,910 mcf of casinghead gas, and 454,642,697 mcf of dry natural gas.

Production in the year 1957 totaled 51,444,567 bbl of crude, 1,086,941 bbl of condensate, 48,027,506 mcf of casinghead gas, and 110,500,104 mcf of dry natural gas. Of these amounts, new production discovered in 1957 totaled 302,656 bbl of crude, 306,170 mcf of casinghead gas, and 1,458,413 mcf of dry natural gas.

From a valueless byproduct of the development of an oil field, gas has become valuable enough to warrant exploration and de-

velopment for its own sake. Indeed, some oil men feel that natural-gas production, and its potential, is keeping the offshore development alive. At present $250 million of offshore pipelines are under construction or are awaiting FPC approval.

The highest price now paid for offshore gas is 24.5¢ per MCF, which compares with an over state average of 9¢; nor is there a limitation on the production of natural gas except for that limitation imposed by lack of transportation facilities.

Offshore daily oil production is 130,000 bbl. Well allowables have shrunk by 36.6% from those of 1953—which means that a well of 10,000 ft to 11,000 ft has allowable production of 178 b/d, as compared with 545 b/d in 1953.

This inequity—combined with the high cost of offshore drilling and the difficulty encountered, because of weather and sea, in bringing offshore oil to market—has prompted leaders in the industry to appeal to the authorities for relief. One proposal is that the authorities grant two additional brackets for offshore allowables. This formula, also suggested by Mr. Dykstra, would provide that wells in more than 20 ft of water be given a "deep-water allowable," higher than the offshore allowable; and that wells in more than 45 ft of water be given a "blue-water allowable," which would be higher than the allowable of a deep-water well.

In actual amounts, this would not mean a large increase in offshore production, but it would furnish a needed stimulus for offshore development.

Another suggestion offered to the authorities would permit the allowables to be taken over a certain period of time—say three months—rather than on a daily or monthly basis. This would allow a well to "catch up" with its production if forced to shut down because of weather at any time during the 90-day period. Oil men operating in the Gulf of Mexico say that a vast amount of production is "lost" because of weather.

Of all the water operations throughout the face of the earth, they say, the Gulf of Mexico is the worst from the standpoint of weather and sea conditions. The long "fetch" of the sea against the unsheltered gulf coast—driven by prevailing south winds over great expanse of water, plus the comparative shallowness of the gulf—creates unusual turbulent conditions. Vicious tropical storms develop in the space of a few hours. Mounting seas which break over the offshore platforms and drilling structures make it impossible to bring production barges alongside.

Since offshore platforms have only limited storage facilities, it is frequently necessary to shut down wells for comparatively long periods to await the abatement of stormy weather. Thus much allowable production is frequently "lost" to the owners because they are unable to collect the oil for transportation to the nearest pipeline terminals.

The platted area of offshore Louisiana and Texas embraces some 18 million acres, and leases have been granted to cover 4,272,439 acres. During the period 1945 to 1948, the state of Louisiana granted 743 leases of 5,000 acres each and bonuses totalling approximately $26 million; or $10 per acre, on an average, were collected from the oil companies.

Leasing was suspended after the US Supreme Court decision of 1950, which ruled that the USA has paramount rights which transcend mere rights of ownership in the states; and it was not resumed until the Congressional Submerged Lands Act of 1953, which gives title to the states to their "historic boundaries." Since that time, Louisiana has collected an additional $90 million in lease bonuses, with rentals totaling $22 million.

Texas has received the smallest revenues, although she was the first to grant offshore leases. Texas' total receipts amount to $63 million, of which bonuses have totaled $58 million, rentals $4 million, and the balance has come from royalties and exploration fees.

The US government began leasing in August 1953, the effective date of the outer Continental Shelf Lands Act. Since that time the federal government, through its Department of Interior, has collected $309 million—which includes $248 million in bonuses, $27 million in rentals, $33 million in royalties, and $1 million in shut-in gas payments.

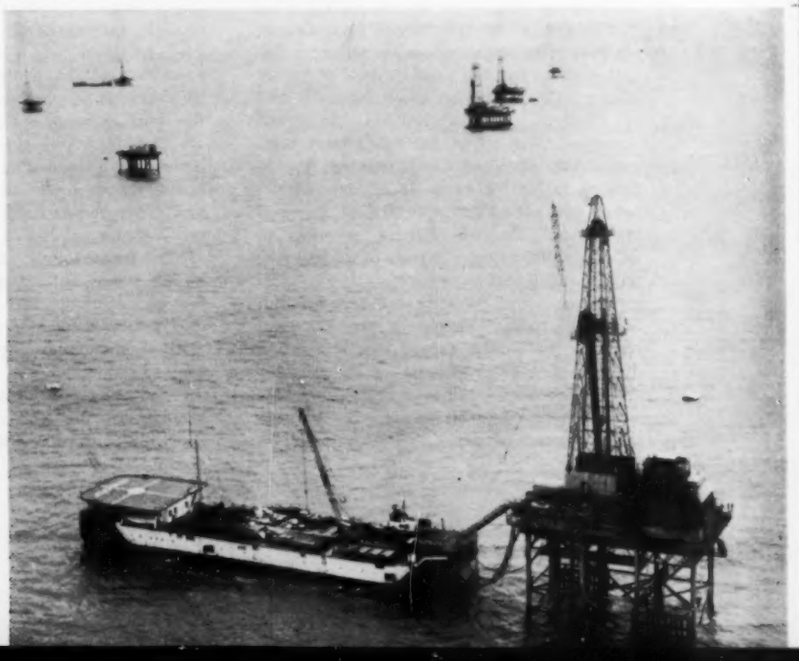
In addition, oil companies have paid into an escrow fund of the federal government and the state of Louisiana a total of $94 million pending such time as the Supreme Court can settle a boundary dispute resulting in a controversy over the interpretation of the state's "historic boundary." The escrow agreements between Louisiana and the federal government was reached in 1956, and the fund is growing at the rate of approximately $1 million per month.

All of this adds up to well over half a billion dolars laid out by oil companies before even starting on the drilling and production costs.

Now consider what it costs to drill a deep-water oil well. The cost of seismic parties is about $1 million per month. Drilling costs change, of course, with the location and size of the installation; but the operation of a rig alone averages about $5.00 per minute—varying between $2.77 and $6.79. By distributing the cost of the platform, well jacket, casing, tubing, and other equipment over the operating days of an offshore installation, it runs to a figure varying between $5,000 and $17,000 per day.

Coral Drilling Co.'s new submersible drilling barge, "Mr. Arthur," showing the new light-weight drilling mast installed by Lee C. Moore Corp. Weight of the derrick was reduced by 7½ tons by use of a new high-strength steel.

This is a typical offshore oil and gas field, showing (in foreground) a small permanent platform and tender, and (background) two self-contained platforms (at right) and a compressor platform (at left). It has become established practice in offshore operations to drill wildcats with the mobile units which can be moved from one location to another, and to develop proved fields from the permanent type platforms (Cities Service photo, by Anthony Linck).



Today the emphasis is on economy, and most major oil companies operating in the tidelands area have instituted definite programs designed to get "more hole for the dollar." One major company operates one rig of its own as a "laboratory" to experiment with such factors as bit weights, drilling speeds, mud pressures, etc. From its findings, engineers are able to lay out comprehensive drilling programs for the company's various contractors.

There has been an appreciable reduction in wildcatting this year, and more emphasis has been placed on development drilling. For instance, the CATC group (Continental, Atlantic, Tidewater, and Cities Service)—probably the largest operator in the offshore fields—has cut down its exploratory drilling to three or four wells this year. In its peak, when practically all wells were wildcats, this group's programs would run to 25 or 30 wells per year.

"Most domestic companies have the same problems," explained M. S. Kendrick, of Continental Oil Co., who is general manager of the CATC group operation. "We all need reserves, but right now we also need to get revenue."

There is really nothing spectacular in these "cost-cutting" procedures. There has been no revolutionary development in drilling equipment or techniques; but on wells where these programs have been put into effect, drilling time has been cut almost in half—realizing savings in some instances as high as 35%.

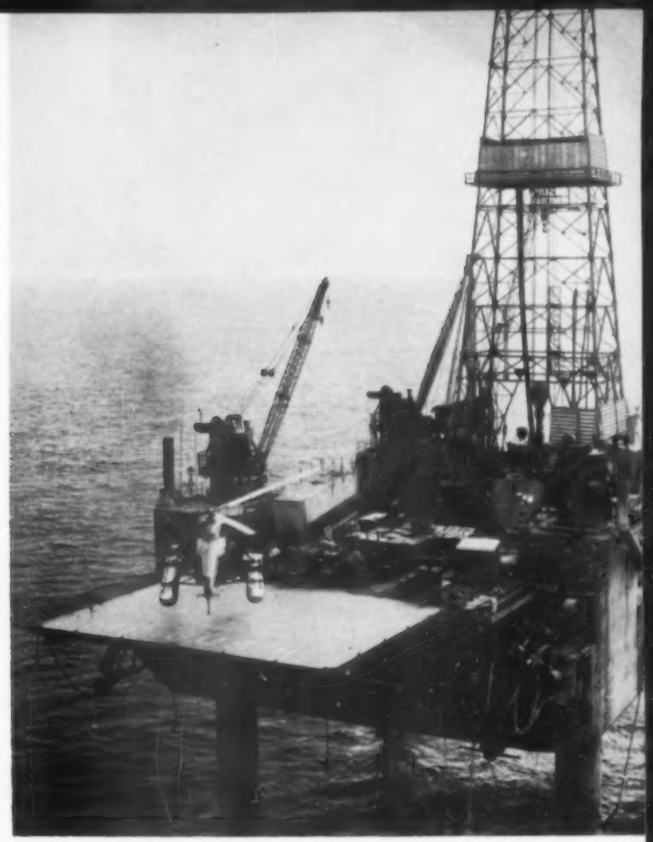
Drilling speeds have been increased by doubling the weight on the bit and by increasing rotary speeds. For example, weights on a 9⅞-in. bit have been increased to 20,000 to 60,000 lb from former 10,000 to 30,000 lb.; and rotary speeds, which formerly ranged from 150 to 80 rpm, have been increased to the 150 to 125 rpm range.

To prevent deviation in the piercement-type formations prevalent in the gulf offshore fields, engineers are increasing the size of collar strings—even at the risk of collar sticking—and are using stabilizers.

The engineers have found that, for progressively greater drilling weights, optimum drill-collar size more closely approaches hole size, and is indicated to be approximately ½ in. less than hole size where relatively heavy weights are used.

Use of the stabilizers in the drill-collar string decreases the angle of applicaion of weight on the bit to the angle of the hole. The function of the stabilizers is to eliminate the deviation tendency caused by additional weight, and to increase the force tending to bring the hole back to vertical. The stabilizer consists of three spiral blades welded to a drill collar—with each blade covering 180 deg of collar to insure full-circle contact.

A normal program comprises the listing of all costs; then selecting cheaper alternatives. Many companies have quit cementing 16-in. casing, and are now driving conductor pipe to about 420 ft before drilling. There has been a reduction in mud weights —which not only saves on cost, but permits greater penetration rates. Engineers have found that muds formerly used were too heavy, anyway. The engineers are finding that, by more closely watching their drilling programs, they are able to corect many mistakes they had been making all along. Too heavy mud was one of them.



"Mr. Gus II," giant mobile drilling rig of Glasscock Drilling Co., is shown on location in 137 ft of water in the Grand Isle area drilling for the CATC group. This well, a triple completion, was drilled in the deepest water yet encountered in the gulf offshore fields (Cities Service photo, by Anthony Linck).

Up to mid-1957, the record for a 7,500-ft hole was 6½ days. During the first quarter of 1958, they were jet-drilling a 7,500-ft hole in 4½ days, a reduction of better than 30% in total drilling time.

Recently Shell Oil Co. set still a better record in its OCS 0582 No. 1 in Ship Shoal area, Block 139, i.e., by drilling 10,750 ft in 12 days.

In the light of the new cost-cutting programs, several companies have considered the use of turbo drilling with diamond bits, which would permit drill speeds up to 750 rpm—far greater than conventional drilling. The diamond bit has a slower penetration that the rock bit—the primary advantage being that it can be used for five days between "round-trips." Another method strongly considered is the percussion drill. Neither of these methods has as yet been used in offshore wells, but they are possibly in the offing.

Drilling supervisors have been instructed to give careful consideration to the five factors comprising footage costs: pentration rate, bit life, round-trip time, bit cost, and hourly rig cost—and to take all possible steps to cut daily costs by increasing footage.

Serious thought is now being given to workover problems—which have not been too serious thus far, since the offshore fields are really too new to have required a great amount of workover.

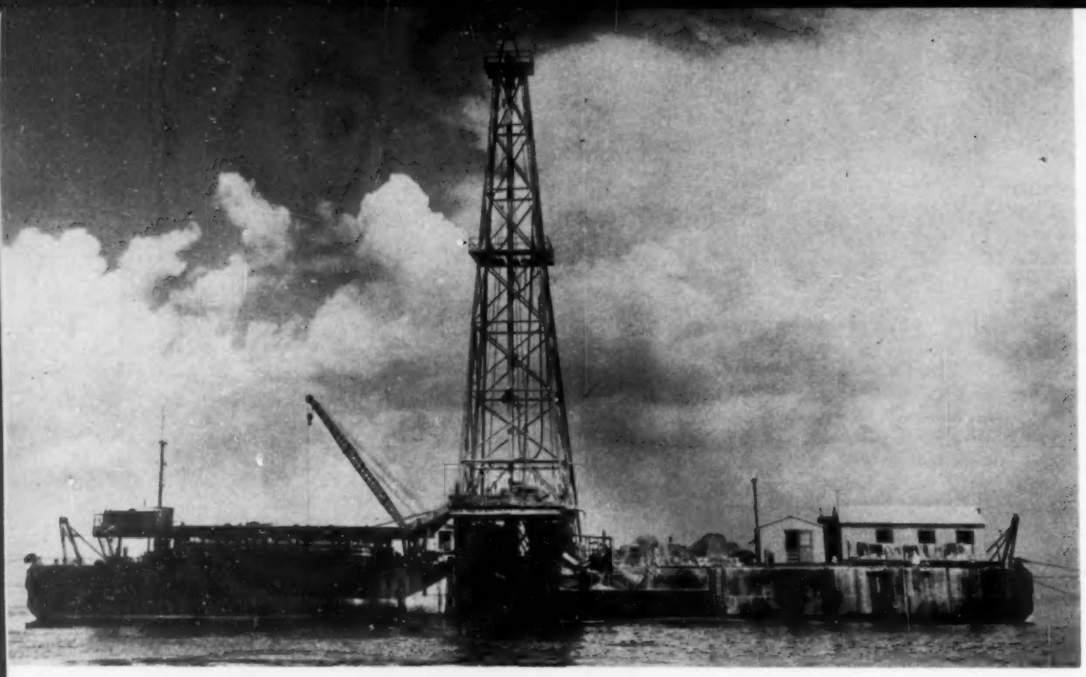
"We're just on the brink of it now," said one oil-company executive. "What little workover has been necessary, we've done with conventional drilling rigs. Naturally, this has been expensive, and we've done some serious planning to try to bring down these costs before the real workover jobs hit us."

Several types of workover rigs have been suggested. One is a small rig which could be set on top of the well jackets; but even this would require the use of standby derrick barges, and these vessels run to $10,000 per day rental. Another idea is a light mobile rig on a self-propelled vessel which could set up the workover equipment on platforms with its own crane. On larger multiple-well platforms, it is likely small workover units will be "moth-balled" and left permanently to handle workover problems as they arise. This, of course, would be practical only for those structures supporting 12 or more wells.

But with all the need for economy, the oil prospectors are looking farther seaward —moving into deeper water, even closer to the rim of the continental shelf.

Completion of two wells in the deepest water yet undertaken in the Gulf of Mexico —one from the largest mobile unit to be built, and the other from a permanent platform—was one of the highlights of the offshore drilling program during the first quarter of 1958.

Using the giant $6 million mobile platform "Mr. Gus II," CATC finished a triple-completion well in 137 ft of water in the Grand Isle area, Block 70, about 25 miles offshore and 2½ miles from the nearest production. The wildcat—producing from three zones—was completed at a total depth of 13,495 ft. It flowed at a daily rate of 235 bbl of 32-deg-gravity oil, from perforations



Brown & Root's drill barge "Champion" working off Galveston in the first gulf drilling from a floating vessel: The "Champion," 220 ft by 55 ft by 18 ft, is the largest of three such barges designed and built by Brown & Root. This vessel and the barge U-303 drilled 34 test wells for sulfur in a program for Texas Gulf Sulphur Co., the deepest to 3,500 ft. Brown & Root engineers believe it possible to drill for oil and gas in deep water offshore from a larger vessel of this design. Secret of the Brown & Root floating drill-barge operation is in the system of anchorage. The derrick and drawworks are set on an outrigger over the side of the barge, and a 12¾-in. conductor pipe is driven to a 50-ft penetration.

between 8,356 ft and 8,372 ft, on an 8/64-in. choke. It had a daily rate of 190 bbl of 28.1-deg-gravity oil from perforations between 8,414 ft and 8,422 ft. The third level was between 9,240 ft and 9,254 ft, which produced 75% oil and 25% water, but no gauge of the flow was taken.

"Mr. Gus II," owned and operated by C. G. Glassock Drilling Co., of Corpus Christi, Texas, was designed to drill in water up to 150 ft.

Shortly after CATC's record-breaking discovery, Gulf Oil Corp. drilled in 136 ft of water in Block 130, South Timbalier area, to set a record for a well drilled in the deepest water from a fixed platform. The previous record—also drilled by Gulf—was in 120 ft of water in Block 135, South Timbalier area.

The practice of drilling from a floating barge, similar to the technique of core drilling off the California coast, was introduced to the Gulf of Mexico by Brown & Root Marine Operators Inc.—working in conjunction with McClelland Engineers Inc., of Houston. It offers the promise of drilling in areas of the tidelands where water is too deep for the conventional mobile structures or permanent platforms.

This was first attempted, successfully, by the two Houston concerns two years ago, when they towed a specially constructed barge 3,000 miles to make foundation borings in Passamaquoddy Bay for a proposed power project. Operating in tides up to 24 ft, it was necessary to devise a heavy anchorage system which would hold the drilling barge in place.

Upon their return to Houston, the engineers in charge of the project began the design of a larger and more complete barge for drilling test wells in the Gulf of Mexico for Texas Gulf Sulphur Co. This barge, the U-303, 190 ft long, 50 ft wide, and 11 ft deep, conducted a 34-well drilling program off Galveston and High Island—operating in water up to 30 ft in depth. Deepest hole depth was 3,500 ft. The barge U-303 was later supplemented by a larger vessel, the barge "Champion." Since completing the sulfur boring job, the operators of the unique drill barges have been approached by several oil companies regarding the possibility of deep-water drilling for oil.

Brown & Root engineers say the best application for this type of drilling, at the present time, is in areas other than the Gulf of Mexico—which they regard as the "worst in the world," but they say they are willing to try. They are certain, however, that it will be necessary to build a barge bigger even than the Champion to attain the hole depths required for oil and gas. The barge U-303—equipped with a Lee C. Moore jack-knife derrick and an anchorage system which is the "trade secret" of the Brown & Root operation—is capable of drilling to about 5,000 ft. The Champion, which is 220 ft long, 55 ft wide, and 18 ft deep, has a Cardwell L-350 drawworks powered with a twin GM 671 engine and a derrick especially designed by Brown & Root for water drilling to depths up to 6,500 ft.

Several large new mobile drilling rigs, of the submersible and self-elevating type, have been completed this year or are nearing completion in shipyards around the gulf area. The largest completed to date was the 9,000-ton "Mr. Gus II," a self-elevating giant which has the distinction of being the most costly drilling structure put into service. Coral Drilling Co. introduced its "Mr. Arthur," featuring Lee C. Moore Corp.'s new light-weight offshore drilling mast. Moore engineers cut 7½ tons off the weight of the 140-ft mast by the use of "USS Man-Ten Steel," a high-strength steel developed by United States Steel and supplied through Tennessee Coal & Iron Division, at Tulsa.

Trans-Gulf Offshore Drilling Co. introduced its rig No. 10, designed by Trans-Gulf vice president William H. Flynn, and built by Port Houston Iron Works, at Houston. Measuring 185 ft by 87 ft by 21 ft, the self-elevating barge is capable of drilling in water up to 75 ft in depth. Towed as a barge to location, rig No. 10 lowers its 2 caissons to the ocean floor, and then elevates itself into drilling position by means of an hydraulic jacking system which not only raises and lowers the caissons and hull, but also operates ram-jacks for skidding the substructure to multiple drilling positions.

Another triangle LeTourneau mobile platform went into the service of Reading & Bates Offshore Drilling Co., of Tulsa. About one-third smaller than earlier types of LeTourneau units introduced to the offshore oil fields, the Reading-Bates platform is rated to drill in water more than 85 ft deep. The unit is 152 ft long, 138 ft wide, and its hull is 15 ft deep. The self-elevating platform is supported by three 140-ft spuds. Christened "C. E. Thornton," the new mobile unit went to work for the CATC group in Block 115 of the East Cameron area, off the Louisiana coast.

At least five more mobile units of various types are now under construction—with completion scheduled before the end of the year. The "Lloyd Noble," a twin-hull submersible platform belonging to Noble Barge Co., is nearing completion by Avondale Marine Ways, New Orleans. The structure is 217 ft by 100 ft in size, and is designed to drill in water up to 100 ft deep.

A smaller twin-hull submersible, also designed for 100-ft water drilling, is being built by Levingston Shipyard—at Orange, Texas—for Placid Oil Co. It measures 178 ft by 72 ft. Southern Shipbuilding Corp., Slidell, La., is building a Hayward-type submersible barge for Rimrock-Tidelands, which will be the fifth Rimrock rig to go into service in the gulf. It will operate in waters from 12 ft to 35 ft.

Houston, Texas, now has two mobile units under construction, Universal Drilling Co.'s self-elevating "Mr. Louie" at Port Houston Iron Works, and Union Producing Co.'s new 160-ft submersible rig at Todd

Shipyards Corp.—soon to see service.

Newest addition to the "swamp rig fleet" was the submersible drilling barge "Mister E.J.," built by Levingston Shipbuilding Co. for McNisco Inc., of Houston, and named in honor of the founder of the Nicklos Drilling Co., the late Mr. E. J. Nicklos. The vessel is 180 ft long, 50 ft wide, 12 ft deep, and departed early in the spring for its first marsh-land drilling assignment in Louisiana's Mallard Bay.

There is a tradition about the bayous of Louisiana. These tidewater streams—created over the ages by the meandering of the Mississippi River—have formed a way of life for the happy fun-loving natives of South Louisiana, who have always looked to these winding, oak-covered estuaries for their livelihood as well as their social life.

Bayou Beouf had been no different from the rest—until oil was discovered in the Gulf of Mexico. Because of its accessibility to the sea, Bayou Beouf (pronounced Burf) was transformed overnight into a bustling industrial waterway, whose banks are lined with grotesque drilling structures, barges, work boats, tugs, and work craft of every type and description.

On the bank of this once-tranquil stream, near Morgan City, is located McDermott Fabricators (formerly Bayou Beouf Fabricators), a subsidiary of J. Ray McDermott & Co. Inc.

"We had to change the name," explained manager H. W. Bailey. "Many of our out-of-state customers didn't know what a bayou is, and couldn't pronounce 'Beouf'!"

Here McDermott fabricates the towering templet jackets which form the foundation for the permanent drilling platforms erected in the offshore oil fields. The tallest structure yet to be erected in the gulf was built there. Weighing 437 tons—with legs 160 ft in length and 36 in. in diameter—the structure is 40 ft by 151 ft, and formed the platform on which Gulf drilled a well in 136 ft of water. The templet consists of eight legs through which steel piling was driven 175 ft into the ocean floor.

Recently McDermott fabricated and erected the largest structure in size, a massive island eight miles from Grand Isle, from which Freeport Sulphur Co. will develop the rich sulfur deposits discovered by Humble Oil & Refining Co. It consists of four units—a drilling section, living quarters, power platform, and bleed-water platform; and the units are connected by 225-ft steel bridges. The units themselves are 106 ft by 220 ft in size, and 70 ft high.

About a year ago, McDermott began experimenting with aluminum in the construction of jacket templest for Lake Maracaibo. These structures were partcicularly adaptable to the Venezuelan oil field because of their corrosion resistance, speed of installation, and the fact they can be easily salvaged and transported to other drilling locations. The templets are 40 ft by 30 ft at the top, 55 ft by 65 ft at the bottom, and are tall enough to form a platform to drill in 90 ft of water. Each uses about 80,000 lb of aluminum, supplied by Reynolds Metals Co.; and McDermott builds one every 4½ days. A tow, loaded with the aluminum pipe jackets, leaves the McDermott yard on Bayou Beouf every 20 days, bound for Lake Maracaibo.

Another oil-field marine builder recently entered the aluminum field when Bryant Boats Inc., of Bayou LaBatre, Ala., completed the first all-aluminum tug, a 55-ft ABS-approved vessel designed for oil-field work. Kaiser Aluminum & Chemical Corp. supplied the metal for the shallow-draft tug "M/V SUMTER," named for the first warship of the Confederacy.

On the legal side of the gulf tidelands development is the controversy between Louisiana and the federal government over title to the submerged oil lands—a matter scheduled to be argued before the US Supreme Court in October. In this case (United States of America, plaintiff, vs. State of Louisiana) the Supreme Court faces the difficult task of interpreting the historic boundary of the state.

The federal government claims that Louisiana's title to the tidelands extends a distance seaward of three geographic miles from shore; Louisiana contends, based upon its admission to statehood in 1812, that its historic boundaries include "all islands within three leagues of the coast," or 10½ miles seaward from the coast.

While Congress, in its Submerged Lands Act of 1953, quit-claimed to the states all title to submerged lands within historic boundaries, the Department of Justice has held that the national policy has consistently been to control a three-mile maritime belt, and thus disputes Louisiana's title to three leagues.

That, basically, is the argument!

In 1956, the state of Louisiana (represented by the State Mineral Board) and the federal government (represented by the Department of the Interior) agreed to permit drilling in the disputed areas under an escrow agreement, and divided the offshore areas into four distinct zones.

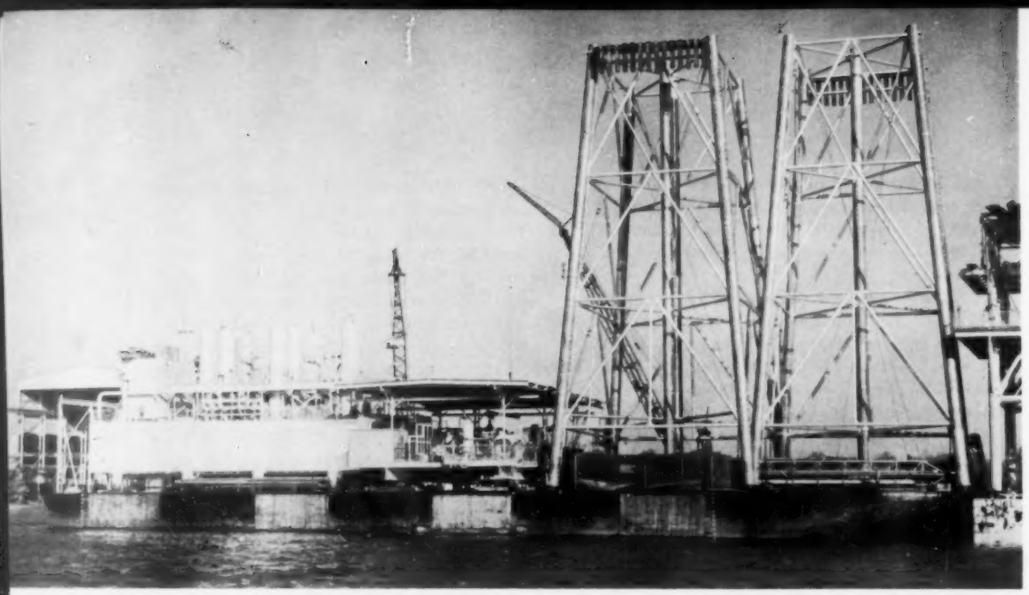
Zone 1 extends three miles seaward from the line drawn by the Department of the Interior, which serves as a base for the measurement of present lease blocks. This line was expected to set the boundary where the Gulf of Mexico meets the shores of the state. Drawn by engineers in the Bureau of Land Management during the administration of former Secretary of the Interior Chapman (and since referred to as the Chapman line), this base line has been disputed by the Louisiana Mineral Board, but will be used until the controversy is settled. Leases in this zone are conceded to belong to the state.

Zone 2 is the area from the present three-mile line to the three-league line, about 10½ miles seaward from base line.

Zone 3 is the area three marine leagues seaward of a line adopted by the Louisiana legislature in 1953 as the "coast" of the state. The legislature, in taking this action, simply used the line of demarcation established by the US Coast Guard as the division between "inland and international rules of the road."

Zone 4 is the area seaward of this border, and is to be administered by the US

A river tow boat and tug push the three-legged mobile drilling barge "C. E. Thornton" sedately down the Mississippi River, en route to its first offshore drilling assignment. The economy-size self-elevating rig, built by R. G. LeTourneau Inc., at its Vicksburg, Miss., plant, was delivered to Reading & Bates Offshore Drilling Co., of Tulsa. This vessel is about two-thirds the size of the original LeTourneau rigs. The "C. E. Thornton" weighs 3,000 tons, and cost $2 million to build.



Barge load of "aluminum wear" leaves the Bayou Beouf yard of McDermott Fabricators for Lake Maracaibo. This all-aluminum unit, built to withstand corrosion, consists (from left to right) of a flow station, pumping platform, and templet jackets. It was delivered to Superior Oil Co., in Venezuela.

Department of the Interior—although Louisiana does not relinquish claim to its ownership.

All oil leases in Zones 2 and 3 are governed by escrow agreement between the state and federal governments, and all moneys collected are placed in escrow to be divided after settlement of the controversy. The escrow fund is now growing at the rate of about $1 million per month.

The two governments are in disagreement over the base line, however; and, in order to make a recommendation to the US Supreme Court, a joint committee was appointed by the State Mineral Board and the US Department of the Interior to determine the contact line at mean low tide between land and sea. This would establish a definite base line from which to determine ownership.

The committee—consisting of four technical men and two attorneys—is headed by Dr. Gordon I. Atwater, of New Orleans, a consulting geologist and vice president of the American Association of Petroleum Geologists. Other members of the committee representing Louisiana are Monte Hayne, Louisiana state engineer; and Scott Wilkinson, of Shreveport, an attorney representing the State Mineral Board in the boundary dispute. Representing the United States are Earl Harrington and Donald Clement, of Washington, D.C., members of the cadastral engineering staff of the Bureau of Land Management, and an attorney for the Department of the Interior.

According to Dr. Atwater, about 75% of the Louisiana shore line is well defined with a beach about 3 ft to 4 ft high. In 1953, after passage of the Submerged Lands Act, the oil companies operating in the offshore area jointly made an aerial survey of the shore line, and the committee has agreed to accept this study as sufficiently accurate.

With this aerial study as a base, the US Coast and Geodetic Survey was commissioned to map the shore line, and has prepared a series of 41 maps, on a scale of 1 in. to 16,666 ft, which defines a "meandering line" with established turning points. This has been converted to plain coordinates based on the Louisiana-Lambert system of coordinates, and will enable the committee to find any predetermined point at any time in the future, or to determine any line offshore.

There are three sections of the Louisiana shore line, however, which have required tidal studies: the Mississippi River delta, the Atachafalaya Delta, and Marsh Island. Because tidal fluctuation on the gulf coast is so slight as to have no effect upon navigation, the US Coast and Geodetic Survey had never before made tidal observations between Biloxi, Miss., and Galveston, Texas; and is was, therefore, necessary to set up tidal observation stations in the three questioned areas and begin a study estimated to require 1½ years. For the purposes of the title controversy, "pinpoint" accuracy is essential. An error of a fraction of an inch in the Louisiana shore line would conceivably make a difference in thousands of acres of land.

This is the first time in the history of the US Coast and Geodetic Survey that it has been called upon to determine if vertical measurement would have a bearing on horizontal position.

The offshore controversy may gain international stature when Louisiana congressional representatives appear before the 87-nation conference on Law of the Sea in Geneva, Switzerland.

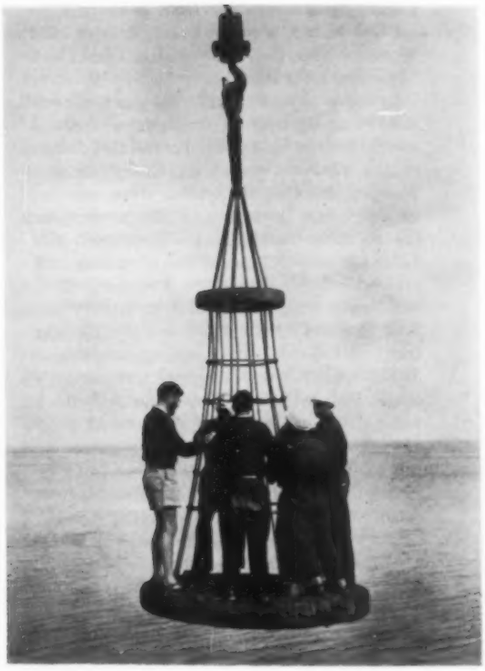
One provision which has been propsed in this conference is that all lands in all waters past the three-mile limit be placed under international jurisdiction.

If this takes place, according to New Orleans' Leander H. Perez, a leader in the fight for state control of the tidelands, there would be no reason why a foreign country could not establish a claim to the tidelands oil fields on the same footing with the United States.

Mr. Perez, who is district attorney of two parishes, St. Bernard and Plaquemine, whose shore line adjoins the heart of the offshore development, has urged Louisiana congressmen attending the conference this summer and fall to oppose the proposal of the US State Department.

Under this provision, explained Mr. Perez, any coastal areas stripped away from the state's historic boundaries and thrown into international waters would be placed beyond the jurisdiction and control of the USA. END

Marine-type noncorrosive aluminum found a new application in the offshore oil fields with the introduction recently of the first all-aluminum tug to be constructed, and the first aluminum vessel to be built to American Bureau of Shipping standards. The tug "M. V. Sumter," shown here undergoing tests at the builder's yard, Bryant Boats Inc., on Bayou LaBatre, was designed for use in the gulf and in Venezuelan marine oil fields where corrosion has become a serious problem.



"Personnel lift" for conveying persons from launch to drilling platform aboard "Adma Enterprise" at site of Adma well F-1 being drilled by Abu Dhabi Marine Areas Ltd.: Height of the lift is about 50 ft. Space inside cage is used for luggage. (PB photo).

Five years of work precede BP drilling in Persian Gulf

As the culmination of nearly five years' work by many specialists, the first offshore well to be spudded in by Abu Dhabi Marine Areas Ltd., in its Persian Gulf concession off the coast of the small shiekdom of Abu Dhabi, began drilling early this year. ADMA is owned two-thirds by The British Petroleum Co., whose exploration subsidiary, BP Exploration Co., is the operator, and one-third by Cie. Française des Pétroles.

This is the first project of the kind to be undertaken by BP, and had to be executed at a time when the company had no main base of operations in the Persian Gulf. Consequently, all planning had to be done at long range in the United Kingdom; and all equipment and facilities for the various surveys, for the base set up on the small island of Das, and for the drilling platform, had to specially provided for the project.

The concession covering 12,000 square miles of the continental shelf of Abu Dhabi was obtained in March 1953 by BP Exploration Co. and CFP; and, with the permission of the ruler of Abu Dhabi, was assigned to ADMA. The concession provided that within one year a geological survey should be undertaken and that drilling was to start within five years.

For the geological survey, ADMA broke new ground and engaged Captain Jacques Cousteau who—with his team of divers, using aqualung equipment—brought up from the sea bed many interesting pieces of rock for examination by BP geologists back in London. In addition, the ship carried a small gravity team from the Geophysical Prospecting Co. with a North American Marine gravimeter. Over a period of two months, 400 gravity stations were established over a series of lines six to seven miles apart, with station intervals along the lines varying from 2½ to four miles. This joint geological and gravity survey commenced in February 1954, and was finished by mid-April. Results of the survey were of considerable value in continuing into the area the major gravitational trends which had been established on the adjacent land; and the general shape of the gravitational map was helpful in formulating a program of seismic observations designed to outline any structural highs existing within the Abu Dhabi area in sufficient detail for the purposes of a well location.

Marine seismic reflection observations commenced in December 1954, and were completed four months later. The observations were made over a network of lines

His Excellency, the Ruler of Abu Dhabi: Sheikh Shakhbut bin Sultan (BP photo).

approximately 10 miles apart, with another set at right angles. In certain selected areas of interest, an extra measure of detailing was undertaken and a few refraction observations were also made in order to learn more of the nature of the geological succession and to aid, if possible, correlation of certain markers with those already identified on the adjacent land.

Altogether, 2,760 miles of traverse were observed over an area of 10,000 square miles—resulting in the production of nearly 12,000 records. All the observations were recorded on Magnedisc (wide-band), as well as by conventional means. The work was undertaken under contract jointly by GSI Ltd. and Geomarine Services International Inc., employing the MV "Sonic." Survey control was provided by the Decca Navigation Co., and this proved to be accurate and dependable throughout the survey. A radio network provided liaison between the "Sonic," the Decca stations, the GSI base headquarters at Bahrain, and the ADMA headquarters at Abu Dhabi.

The seismic interpretation indicated the existence of a number of structural highs—a major one of which, 20 miles east of Das Island, was selected for the first drill test.

Meanwhile, in London, a study group had been set up—which included not only engineers and drilling experts, but also specialists in support services such as civil engineering work, sea and air transport, and telecommunications—as it was obvious these would play a much larger part in this operation than in land drilling. By visits to drilling operations in such places as the Gulf of Mexico, Trinidad, and the National Coal Board's under-water drilling rig in Scotland, members of the study group gained a considerable amount of knowledge on offshore drilling.

The problems of designing a suitable drilling barge werediscussed with contractors and consultants in the United Kingdom; but, following the report of an investigating team on American practice, it was clear that, in the time available, it would only be practicable to use a tried American design. The recommendation by the study group was that the barge should be self-contained, fully mobile, and supported by sea and air from a shore base on Das Island, a mile-square strip of land 90 miles from the coast of Abu Dhabi and 150 miles from Bahrain.

In order to find of what the sea bed consisted and its bearing strength—properties which had to be known before the design of the platform could go ahead—George Wimpey and Co., of London, were engaged to carry out borings and obtain samples for scrutiny and testing. They used the 1,200-ton vessel "Astrid Sven" which had arrived off Abu Dhabi in February 1956, and began work on the site chosen for the first test well. Four holes were sunk and cores recovered; tidal readings were also made, together with current and meteorological observations. The same procedure was carried out at the proposed sites for the other two wells.

Prior to this, A. H. Glenn & Associates, of Houston, were engaged as meteorological consultants. Following a visit to the Persian Gulf by Mr. Glenn himself, a report on the weather and wave forces likely to be met in the area of the proposed drilling sites was prepared.

After investigation, and the discarding for various reasons of fixed and transportable-type drilling barges, it was decided that DeLong Corp., of New York, should design a self-contained drilling barge and supervise its construction and erection on site. The design criteria of the barge were based on the wave heights and forces computed by Mr. Glenn. Very careful consideration had to be given to the incorporation of a shock-absorbing device in the leg-jacking system because of the rock sea bed.

The barge, purely as a constructional problem, presented no difficulties; but the only organization in Europe which could promise delivery in time were Messrs. Gutehoffnungshütte Storkrade AG, of Storkrade-Oberhausen, West Germany. The barge was built at Audorf, on the Kiel Canal, under the supervision of DeLong Corp. and to the approval of *Lloyd's Register*.

The barge, which was christened "Adma Enterprise," is approximately 200 ft long by 100 ft wide, and has a depth of 15 ft. It has four retractable legs, each 10 ft in diameter and 165 ft long, on which it is elevated or lowered as required by eight DeLong hydraulic jacks. The weight of the barge under operating conditions is approximately 5,225 short tons; and its draft, when afloat, 10 ft 6 in. A helicopter platform is provided at one end.

The barge is equipped with a consolidated National 130 1,600-hp drilling rig, and with plant and tools capable of cementing 7-in. casing down to 14,000 ft. Provision for setting a 5-in. liner some 1,000 ft deeper is available, if required. A consolidated diesel rig was chosen mainly because it could all be contained, after modifications, above deck level. The 140-ft-high derrick is mounted on a 30-ft by 30-ft base, and is capable of a maximum pull of 1,000,000 lb.

Extra blowout-prevention equipment and duplicate control, as is normal on offshore operation, have been provided. One control unit is at the driller's position, and the emergency unit is sited on the main deck behind the bulk chemical hoppers, 90 ft from the well. A normal back-pressure manifold, which simplifies the control of the well when under artificial or formation pressures, has been installed.

Drilling fluid is mixed and conditioned by independent electric propeller mixers; mud mixing itself is simplified by carrying barytes and bentonite in bulk hoppers, from which variable-speed screw conveyors deliver these chemicals to the mixing tank itself. The hoppers are filled by "Bulkans" lifted by a crawler crane installed on the barge. A small chemical tank has been provided over the mud-return fluming for treating the mud in circulation, and a well equipped laboratory is provided.

For cementing, a bulk hopper and a Halliburton triple T-10 unit is supplied which can mix and place cement slurry at the rate of more than 100 tons an hour. Besides cementation, the mud and water circuits are also connected to the triple T-10 unit to enable direct pumping (up to 10,000 psi) to the drill pipe or well head, should the need arise.

The three bulk hoppers built on the barge are capable of handling 140 tons of cement, 125 tons of barytes, and 80 tons of bentonite. In addition, storage capacity has been provided for up to 500 tons of fuel oil; 170 tons of potable water, 900 tons of drilling fresh water or ballast; 140 tons of salt water; and 400 tons of mixed mud.

The method of fresh-water production adopted on the barge is to utilize the waste heat from all the diesel engines to distill sea water in a flash evaporator system. Based on American experience that up to 1,000 US gallons an hour of water can be produced by a waste-heat flash evaporator, a decision was taken to use fresh-water mud for drilling purposes. There are seven diesel engines on the barge—four in the drilling group, and three diesel generators. The installed plant is specified to produce 775 Imperial gallons an hour, utilizing the waste heat from the cooling water of five engines on full load.

To facilitate the movement of large wellhead components, which on land are normally brought in by drilling winch lorry, an overhead rail trolley has been provided to take heavy lifts from the crawler crane. The trolley passes under the pipe rack and directly into the cellar.

Fifty men can be accommodated in air-conditioned quarters comprising two- and four-berth cabins. There is a modern, well equipped kitchen, and a large recreation room. A radio-telephone system has been installed for direct communication with the base at Das Island.

In parallel with the engineering of the barge was the construction of a base on Das Island. Work on the site—a lonely, waterless island, inhabited only by sea birds, scorpions, turtles and mice—began in the winter of 1955, when a small camp was established by ADMA's representative from

Abu Dhabi. This small camp provided a foothill for the main construction force, the first of whom arrived on the island in May 1956. George Wimpey & Co. had been engaged to undertake the construction work entailed in the establishment of the base.

Work soon commenced on a temporary airstrip—the sand being watered and rolled constantly until a reasonably hard-surfaced 4,000-ft-long strip was formed. Twin-engined Dove aircraft on charter were then able to fly in men and essential supplies from Bahrain to the island.

Soon a tank-landing craft, the "Adma One," arrived from the United Kingdom with plant and transport. By skillful navigation, she was able to run her bows onto the beach, and the materials in her holds were hauled out through the bow doors by sheer manpower, supplied by a group of laborers from Abu Dhabi. Before a harbor was available, "Adma One" had made more than 50 beach landings.

Due to severe storms, there were times when fresh-water stocks, which also had to be brought from Bahrain, grew perilously low; but distillation units, capable of producing 1,600 gal an hour of fresh water from sea water, were installed later.

The erection of living quarters was the first consideration. Briefly, the building program consisted of three camps—one for Europeans, one for senior Indian and Arab artisans, and a third for Arab labor; and an industrial area comprising general stores, cement and chemical stores, workshops, an ice plant, power station, administration building, hospital, and helicopter hangar.

Prefabricated bungalows were brought in and quickly erected, while in the labor camp ten 10-men huts, with wooden framework covered with locally made barasti matting walls and roofing, were set up. A mosque was built, and a well equipped kitchen provided.

Harbor works formed a major part of the construction contract—two break-water arms 1,893 ft and 835 ft long, respectively, being required to be built. These enclose a harbor space 1,200 ft long and 400 ft wide, with a loading wharf and dolphins.

From the outset, the location and quarrying of sufficient suitable rock to construct the break water presented quite a problem. Initial investigation showed that sufficient rock should be available; but, after a month's work in a quarry in one corner of the island, there seemed little hope of obtaining the necessary material. The entrance to the quarry yielded only soft rock with an occasional boulder; but, fortunately, as the face receded, the quality of the rock improved. Working day and night, two mechanical shovels dug over half a million tons of rock in eight months. Half of this had to be tipped to waste. but sufficient rock was won to complete the break water and leave a stockpile in reserve.

It took approximately a year to develop the island completely with harbor, airstrip accommodation, technical facilities, and telecommunications; and in June 1957 it was handed over to the operational staff.

Preparations were begun immediately to make ready to receive the drilling platform, which had left Germany in August 1957 on the 6,800-mile tow to Das Island via the Suez Canal. In all, the tow took 92 days—"Adma Enterprise" being battered by heavy seas in the Bay of Biscay, where she was adrift from the tug for some six hours. Two stops only were made—one at Gibraltar and one at Suez.

On November 23, 1957, the barge was off Das; and, even before she was towed into the small harbor, men had been at work preparing to commission her. For six weeks they worked day and night—extending the caissons, completing the drilling rig, and commissioning the various plants. The barge was ready for the move to the first well site 20 miles off Das, January 4, 1958, and drilling began 10 days later in 55 ft of water.

As the sea bottom in the area is hard rock, as distinct from the usual mud bottom, it was not possible to lower the initial conductor pipe into the mud and drive it to its ultimate depth. Instead a 17½-in. bit was used for spudding in, and guided by divers into a 17½-in. inner conductor box on the sea bed. The 17½-in. hole was drilled, then opened out to 23-in., and finally to 36-in.; deviation at the end of the run was half a degree.

Conductor casing of 30-in. diameter was then run to 198 ft, and successfully cemented. From then on, drilling approximated to a normal operation on land; and, as the well proceeded, the 18⅝-in. and 13⅜-in. casing have been cemented at 490 ft and 4,229 ft; respectively. The further casing program may entail 9⅝-in. to be cemented at 9,000 ft; 7-in. cemented at 12,000 ft to 14,000 ft; and 5-in. liner cemented as required.

To maintain the supply of operational stores to the drilling barge, "Adma One" and five 100-ton dumb barges are used. Three specially designed twin-screw 74-ft launches, each capable of carrying up to 20 passengers and 10 tons of cargo—which can tow the dumb barges—cater for drilling-crew changeover and for the transport of urgently required stores. A self-contained refrigeration barge of 30 tons capacity provides for the transport of frozen meat and vegatables, to Das Island from Bahrain, as all foodstuffs are imported through this port.

Weather permitting, overseas cargo vessels discharge into company craft off Das Island. When this is not possible, cargoes are landed at Bahrain for transhipment to Das.

"Adma Enterprise" at site of Adma well F-1 being drilled by Abu Dhabi Marine Areas Ltd. (BP photo).

Weather and sea conditions have to be closely watched, as during certain seasons of the year "shamal" conditions prevail—with consequent sudden changes of wind with high seas.

A British firm, Bristow Helicopters Ltd., is under contract to supply two Westland Widgeon five-seat helicopters with pilots and maintenance staff. These machines are normally used for executives and emergency transportation to "Adma Enterprise"; but during recent months, owing to difficult weather conditions, drilling-crew changes have been made by helicopter.

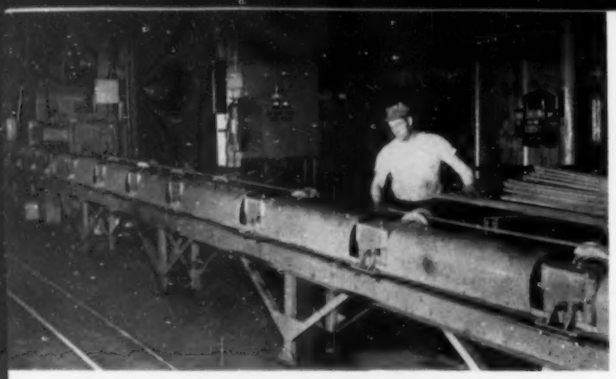
The crews work 12-hour shifts on the barge for six days, and then return to Das Island for three days' complete rest.

Fully equipped radio receiving and transmitting stations are installed on Das Island enabling constant contact with the drilling barge, with Bahrain, Abu Dhabi, and company craft to be maintained.

A bi-weekly charter service of Dove aircraft, operated by Gulf Aviation Ltd., from Bahrain, provides for the transportation of personnel and urgent air freight to and from Das Island

END

Southern end of Das Island, showing part of the stores in foreground—with two-man airconditioned huts under construction just behind: Das Island is being used as base camp for drilling of Adma well F-1, some 20 miles off the island, by Abu Dhabi Marine Areas Ltd. (BP photo).



Rotoblast machine for descaling sucker rods (photo courtesy Oil Well Supply Division, U.S. Steel Corp.).

Gaging sucker-rod pin thread prior to lubricating joint and assembly of protector (photo courtesy Axelson Manufacturing Co. Division of U.S. Industries Inc.).

Forging equipment for upsetting and shaping sucker-rod joints (photo courtesy The S. M. Jones Co. Division of Buffalo-Eclipse Corp.).

Progress in the development of sucker rods for oil-well pumping—PART I

by Lester C. Uren*

In a large percentage of the producing oil wells of the United States, oil is lifted to the surface by use of a plunger-displacement type of pump, immersed in the oil in the well and connected with a source of power at the surface by means of a "string" of sucker rods. The power mechanism at the surface gives the column of rods the necessary vertical reciprocating motion, which is transmitted to the pump plunger. With each upward stroke of the rods and plunger, oil is lifted toward the surface through a column of tubing which surrounds the rods and supports the pump in a fixed position below the level of fluid in the well.

Statistics indicated that upwards of 450-,000 wells in the United States are equipped with rod-actuated plunger pumps. The average string of sucker rods is, perhaps, about 3,500 ft long. Thus, there are something like 1,575,000,000 linear feet of sucker rods in oil-well service in the United States, and their cost averages about 35 cents per foot, or a total investment of $551,250,000. Upwards of 25,000 new wells are equipped for plunger pumping each year, and about 87,500 tons of new sucker rods are required to equip them for pumping service. In addition, many rods in the older wells wear out in service and must be replaced. This is usually high-quality steel, costing about 15 cents per pound, and represents a total annual investment of upwards of $26,250,000. It is apparent that, in discussing sucker rods, we are dealing with an important item in the cost of producing petroleum—representing a large source of income to the steel industry which furnishes the raw material from which sucker rods are made, and also to the manufacturing concerns which prepare the rods for service and supply them to petroleum producers.

In the early wells of the Appalachian region, sucker rods were often made of slender hard-wood poles, coupled together at the ends with threaded joints of wrought iron. The early wells were shallow, and no great stress was imposed on the rods. Though of larger diameter than present-day steel rods, their effective weight was considerably reduced by their bouyancy in the well fluid. Later, as well became deeper, wooden rods were no longer of sufficient strength to withstand the stresses imposed, and wrought-iron rods of smaller diameter were used. And still later, as wells were drilled to greater depths, steel became the universal sucker-rod material. Modern pumping installations in wells, producing from depths as great as 12,000 ft, employ sucker rods of alloy steel having high tensile strength and yield point, and abrasion and corrosion resistance.

In earlier years—and to a large extent even today—sucker rods were connected by box-and-pin types of threaded joints, with a box on one end of each rod and a pin on the other. A wrench-square formed in the upset metal, adjacent to each box and pin, assists in making up the joints as the rods are inserted into the well. Scraping of the reciprocating rods against the inner wall of the tubing often causes excessive wear, particularly of the outer surfaces of the boxes—leading to joint failure when this type of joint is used. To avoid some of the difficulties and expense of rod repair, most manufacturers of sucker rods now provide a threaded pin on each end of every rod, and connect the rods end-to-end by an inexpensive, easily replaced steel coupling. The diameter of the couplings is somewhat greater than that of other parts of the rod string, so that they receive most of the frictional wear (Fig. 1).

Couplings are often formed of the same steel as that used in the rods—center-boring short cylinders of proper length, followed by chamfering and tap-threading. Heat treatment, surface grinding, and case hardening follows. A wrench-flat is milled on each of two opposite sides at the center of the coupling to assist in application of wrenches when the joints are made up. Couplings are case-hardened to resist wear by continued scraping against the inner wall of the surrounding tubing. But wear of the inside surface of the tubing by abrasive action of the hard-surfaced couplings may be of greater concern to the operator than wear of easily replaced couplings. Accordingly, some rod manufacturers provide couplings of softer metal than that used in the tubing, so that most of the wear falls on the couplings. Streamlining sucker-rod joints by rounding-off all corners and edges reduces the flow resistance of oil past the joints and increases mechanical efficiency.

American Petroleum Institute standards prescribe a US Standard flat-top 10-pitch thread for sucker-rod joints. Vanishing threads are provided toward the base of the

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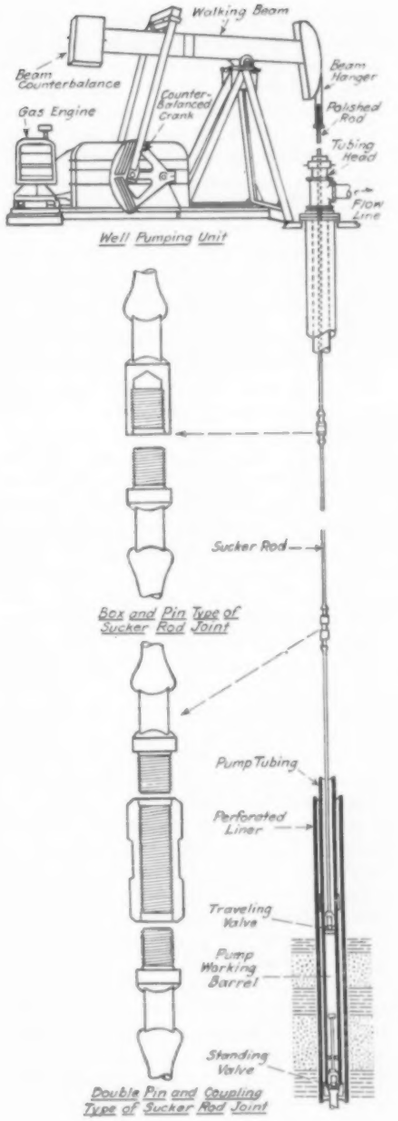
TABLE I

SUCKER ROD DIMENSIONS AND WEIGHTS

Size Rod	5/8"	3/4"	7/8"	1"
Area—Cross Section, Square Inches	.307	.442	.601	.785
A.P.I. Pin Size—O.D., Inches	15/16	1-1/16	1-3/16	1-3/8
Box Diameter (Box and Pin Type)	1-3/8	1-1/2	1-11/16	—
Coupling Diameter (Pin and Pin Type)	1-1/2	1-5/8 or 1-1/2*	1-13/16	2 3/16 or 2*
Weight: Box and Pin Type lbs./ft. 25' lengths	1.080	1.610	2.180	—
Weight: Pin and Pin Type (with coupling), lbs./ft. 25' lengths	1.130	1.630	2.210	2.890
Weight: Pin and Pin Type (with coupling), lbs./ft. 30' lengths	1.120	1.610	2.180	2.850
Distance—face to face of Wrench Flats, inches	7/8	1	1	1-5/16

(Courtesy of Oil Well Supply Division, U.S. Steel Corp.)



pin to provide additional metal to resist breakage at this critical point and to assure secure makeup of joints to resist unscrewing in service. Undercutting the joint by cutting away the vanishing threads at the base of the pin accomplishes a more uniform distribution of stress and prolongs the life of the joint. Though there has been much discussion of the advantages of undercutting the vanishing threads as a means of reducing metal fatigue-joint failures, API specifications do not as yet recognize this practice.

The American Petroleum Institute has adopted standard dimensions for both types of sucker-rod joints which are adhered to by all manufacturers. API standards specify rods of cylindrical form, $\frac{5}{8}$ in., $\frac{3}{4}$ in., $\frac{7}{8}$ in. and 1 in. in diameter. Most manufacturers also sell $1\frac{1}{8}$-in. rods for deep-well service and $\frac{1}{2}$-in. rods for slim-hole production practice. Individual rods are 25 ft or 30 ft long. Table I gives rod dimensions and weights for each of the several standard sizes of API rods.

The API has not attempted to standardize sucker-rod materials, and a wide variety of steels is used by different manufacturers. Most manufacturers offer as many as five different grades of steel, each designed for service under differing well conditions. Some grades of steel give satisfactory service in wells of moderate depth where noncorrosive conditions are maintained (AISI No. 1036). Others of higher ultimate strength and yield point are used in noncorrosive deep wells. For wells of medium depth where "sweet" (carbon-dioxide) corrosion effects must be contended with, a manganese-chromium alloy steel containing a small amount of nickel is available. And for "sour" (hydrogen-sulfide) corrosive conditions, two grades of alloy steel containing larger amounts of nickel are available—in one case treated to develop very high tensile strength and yield point for use in deep wells. If wells are treated to inhibit corrosion, the operator may perhaps avoid the use of expensive high-nickel steel.

The carbon content of sucker-rod steel varies from 0.08% to 0.43%, and is highly important in its influence on strength and hardness. Manganese is invariably used as an alloying agent—as much as 1.50% in the high-carbon steels. Other alloying agents employed in varying amounts to develop desirable properties include chromium, molybdenum, nickel, copper, vanadium, and boron. Each of these alloying metals has its own particular advantages; but, in general, their purpose is to increase the ultimate strength, yield point, elasticity, ductility, hardness, toughness, or resistance to corrosion of the steel to which they are added. Steels containing 1.5% to 3.5% nickel (AISI No. 4621 and AISI No. E-3310 or 4820) resist corrosive influences better than other alloy steels. Nickel-chromium-molybdenum steels have good hardening properties, and are noted for their high strength, ductility, and resistance to shock. Molybdenum in steel improves the heat-treatment properties, and enhances the desirable effects of other alloying elements

The properties of sucker-rod steels are profoundly influenced by the character of heat treatment to which they are subjected in the routine of manufacture. In some cases, the steel is merely "normalized"—which consists in heating above a certain critical temperature and then cooling in air. This produces a fine-grained steel which resists fatigue stress. Sometimes the heat treatment is confined to the forged and upset ends of the rods, but preferably extends throughout their full length. Alloy steels require tempering after normalizing to assure maximum toughness. When steel is heated to a high temperature and suddenly quenched in a liquid (oil or water), rapid cooling produces a "martensite" structure in the metal which, when suitably "drawn" or tempered, is exceedingly tough and fatigue-resistant. Ductility in steel is improved by heating to a temperature below the critical temperature and then drawing or tempering. Accurate control of temperature is an important aspect of these heat-treatment techniques.

Of the physical properties of steel which are important in sucker rods, none are more important than the tensile strength and yield point. Tensile strengths range from 80,000 psi to 135,000 psi, and yield points from 60,000 psi to 115,000 psi. The higher strengths are secured by use of alloys and the more complex methods of heat treatment. Elongation and reduction in cross-sectional area under tension, Brinell hardness, and response to repeated shock loads are also useful tests in defining properties of steel which are significant in sucker-rod manufacture. Most rod manufacturers maintain laboratories equipped with instruments for making these tests and for complete chemical analyses of samples of all incoming shipments of steel. In a complete chemical analysis, the percentages of phosphorous (not more than 0.04%), sulfur (not more than 0.05%), and silicon (0.15% to 0.35%) are determined—in addition to the percentages of carbon, manganese, and other alloying metals.

Manufacturing techniques: The sucker-rod manufacturer makes an important contribution in assuring the oil producer of proper selection of steel for the intended service and uniformity in quality and workmanship in the finished product. Well-pumping service is exacting in its requirements, and often permits of little tolerance in prescribed specifications. Careful inspection of rods at various stages in the manufacturing process will assure compliance with API specifications and uniformity of product. Manufacturers purchase their steel from steel manfacturers in the form of cylindrical rods of rigidly prescribed properties and dimensions.

After a shipment of steel has been received at the rod manufacturer's plant and has successfully passed its mechanical and metallurgical tests, the first step in the manufacturing process involves straighten-

ing and trimming the round bars by passing them through rolls and cropping each bar to its proper length. The ends of the rods are then heated in a furnace maintained at proper temperature by a pyrometer control and subjected to an upsetting and forging process involving several (as many as six) successive operations. Each rod is stamped with an identifying code letter, number or other symbol—both on the wrench-flat and on the end of each pin—to indicate the grade of steel of which it is composed. The rods are then heated throughout their full length in a normalizing furnace equipped with automatic pyrometer temperature controls. After air cooling, the same or a similar furnace is used for a second full-length heating of the rods if they are to be liquid-quenched and tempered. While still at normalizing or tempering heat, the rods are then straightened by a stretching operation. After cooling, the rods are passed through a "rotoblast" machine which effectively removes all scale and confers a surface shot-peening effect which increases fatigue resistance. The upset rod ends are then threaded in automatic threading machines which maintain close tolerances and a constant flood of cutting oil to lubricate the dies and prevent overheating. A careful check with API master gauges assures that the threads and joint dimensions conform with API specifications. The rods are then treated to remove grease, and painted or coated with a baked phenolic plastic for protection against corrosion and surface damage. Manufacturers often use paints of distinctive colors for convenience in identifying different brands or types of steel. The pin threads are greased and fitted with a thread protector to prevent thread damage during transport.

To minimize the danger of damage during transportation, sucker rods are preferably shipped in flat packages, with wooden spacers between to prevent contact of the rods with one another. If rods are not packaged, they should be supported horizontally on wooden storage racks having soft coverings, so constructed that the rods are supported in at least four places—with one support not over 1 ft from each rod end. Strips of wood should be placed between each layer of rods to prevent the upset ends from touching. In unloading individual or packaged rods, they should not be thrown off railroad cars or motor trucks, but should be handled by three men—one at each end and one in the middle—or rolled off on skids so that they are not permitted to sag or bend unduly between points of support. They should never be allowed to touch the ground.

Storage of sucker rods should be in horizontal wooden racks—so constructed that the rods are supported in at least four places, with strips of wood between rod layers. The rod ends should be flush with one another, and sufficient space left between to permit free air circulation. Corrosive atmospheres should be avoided. Any rusty spots on rods should be sanded off and a suitable protective coating applied. Thread protectors should not be removed until the rods are placed in service in a well.

In making up sucker-rod strings in the derrick, individual rods should be up-ended from a horizontal position on the adjacent tubing rack, with a minimum of bending. The thread protectors are then removed, and the rods carefully inspected as they are supported on rod elevators in the derrick; and any that are nicked or kinked or show imperfect threads should be discarded. A string of rods in the well is supported at the level of the derrick floor on a rod hook or "spider"; while individual rods in the derrick are supported on a rod elevator, suspended from a hoisting block operated by a tubing hoist or hoisting drum of a servicing motor truck. Joint threads are carefully examined for defects, wire-brushed, and fresh thread compound is applied as the joints are made up. If hand wrenches are used in making up a new string of rods, each joint should be "bucked-up" twice to assure tightness. Cross-threading should be avoided; but, if it should occur, the joint should be unscrewed, and dies and a tap used to correct any deformation of the threads before the joint is again made up.

It is important that sucker-rod joints should be securely shouldered by application of a sufficient torque to apply adequate and uniform stress on the joint pins. This is difficult to achieve by hand methods, and it is preferable to employ mechanical or air-powered rod wrenches which assure a uniformly applied torque. In "pulling" and disassembling a column of sucker rods, the individual rods are preferably suspended vertically in the derrick from a suitable rod hanger. If this is not available, rods may individually be "laid down" in a horizontal position on suitable wooden supports outside the derrick, after attaching thread protectors. Crew members should not be permitted to walk on rods while they are in this position. Rod joints should never be struck with a hammer, which might create incipient fractures in the hardened outer casing or the coupling or wrench-squares—resulting in subsequent fatigue failure.

Sucker-rod failures in service: Parting of sucker rods in wells is of common occurrence—resulting in complete interruption in pumping service and necessitating repair operations and replacement of damaged parts. The column of rods above the break must be removed and disjointed at the surface, and a fishing tool is then lowered to engage the upper end of the column of rods left in the well. The upper end of the parted column of rods is then hoisted to the surface so that the broken rod may be replaced. Rods comprising the upper part of the column must then be replaced before pumping operations can be resumed. All of this requires several hours of service by a well-maintenance crew, with suitable hoisting equipment and tools. The cost of rod repairs, labor, power, and loss of production during "downtime" of the well may make this a costly operation: one to be avoided if possible, by careful selection, handling, and inspection of the sucker rods.

Failure of sucker-rod joints may result from (1) unscrewing in service; (2) wear of the outer surfaces of the joint by scraping on the inner walls of the well tubing; (3) defects in materials or workmanship in manufacture or damage due to improper handling in transportation, storage, or insertion in the well; or (4) overstressing of rod metal, primarily by metal fatigue, usually accelerated by corrosion.

Though sucker-rod strings are often subjected to excessive jarring and vibration, induced by erratic stress waves, unscrewing of joints while in service in the well should not often occur if the threads are in good condition and they are properly made up. Abrasive wear due to scraping of couplings and rod joints on the well tubing is inevitable, and is likely to be particularly troublesome in crooked holes or in wells which have been deflected from the vertical. Occasional inspection of rods and couplings will disclose points of excessive wear, and will determine when worn rods should be replaced. Breaks resulting from faulty workmanship in manufacture are usually forging or heat-treatment defects in the upset ends of the rods, particularly in the vicinity of the wrench-squares. Fortunately, they are not of frequent occurrence. One authority states that 90% of joint failures are a result of corrosion fatigue of rod metal. The useful service of a sucker-rod joint subject to fatigue stress can be improved by increasing the metal cross-section, thus reducing unit stress; using corrosion inhibitors to reduce corrosive influences; decreasing the range of stress; and avoiding damage of the metal surfaces by scratches, nicks, or deformation which may create focal points for fatigue failure. Undercutting the vanishing threads at the base of the joint pins may also reduce fatigue stresses.

Much of the abrasive wear of sucker-rod joints is concentrated on the couplings—particularly in crooked holes where most of the wear occurs on one side of the couplings. Use of rod-and-tubing rotors will distribute this wear and give longer life to the rods. Ultimate failure of couplings is usually a result of metal fatigue in metal cross-sections weakened by wear, and often occurs at the point which coincides with the first thread on a pin. The start of a coupling break sometimes is on the outside surface in the vicinity of a wrench-flat—caused, perhaps, by a hammer blow which cracks the hardened case. More frequently, failure starts on the inside of the coupling at the root of a thread—usually hastened by a corrosive well fluid which seeps through the threads and accumulates in the free space between the two pin ends in the coupling. Placing a little corrosion inhibitor in these spaces as the joints are made up may reduce these inside corrosion effects. Rounding the roots of the sharp *V*-threads in the couplings also reduces fatigue vulnerability.

Note: Part II of Dr. Uren's article will appear in a subsequent issue, which also will contain the bibliography. END

A nonfermentable starch for drilling fluids

by William L. Owen* and William A. Romans*

Starch for drilling fluids previously reacted with Ortho-benzyl Parachlorphenol has been found to be resistant to rapid deterioration by micro-organisms in fresh-water fluids—thus increasing the areas in which the starch may be used to reduce water loss.

OF ALL the colloidal materials added to drilling fluids for the purpose of maintaining the proper consistency in the muds and to retard water loss during drilling operations, starch is one of the oldest, the most versatile, and the simplest to apply. It is one of the most flexible; as to the conditions under which it is effective, one of the easiest to use, and one which requires a minimum of safeguards as regarding its freedom from toxic or irritating fumes, and/or its irritating effects when brought into contact with the skin. Another factor which contributes to its popularity in all types of drilling procedures is that it is in abundant supply.

The price of starch remains stable, and its use economical, where it is not exposed to conditions conducive to deterioration by the action of microörganisms. These latter limitations render it necessary to use starch only where pH of the fluid is above the range of microbial activity [11,5], or where the fluid is rendered immune to microbial action by the use of copious additions of sodium chloride or other preservatives. Under other conditions inherent in fresh-water mud systems, it is essential to add preservatives to the fluid to induce a bacteriostatic condition extraneously to the added starch.

Among the most frequently applied preservatives may be mentioned the following: [1] chlorine and chloride of lime, formaldehyde, bichloride of mercury, paraformaldehyde, pentachlorphenate, etc. Cannon [2] suggests, according to Beerstecher [8], that often the cost of the preservative is much greater than that of the starch to which it is applied and designed to protect. And it may be remarked that even the maximum of extraneously applied preservative does not always accomplish the intended results.

As may be readily assumed, unprotected starch is susceptible to the deteriorative action of almost a countless number of species of microörganisms which abound in soil, water, and the atmosphere. Not only is it from these sources that drilling fluids derive their microflora, but the clay itself usually carries its own autophytic and endogenous bacterial flora; so it is to be expected that the instant starch in a fresh-water mud is introduced into the soil strata, it is attacked by a heterogeneous assortment of bacteria.

Of the species which are most likely to occur, we have the usual soil sporogenous species of bacteria—among which the most prevalent are: Bacillus *megatherium* and B. *subtilis*, B. *vulgatus* and B. *mesentericus*, and many of the Streptomices, which occur normally both in water and in soil. The Clostridia also are often prevalent, among which the C1. *butyricus* and *pasteurianum* are frequently encountered. The variation is infinitely great—depending upon the type of soil, the type of clay, and the bacteriology of the water used in the makeup of the mud.

In the bacteriology of high pH muds or saturated salt systems, the microflora is screened to a point where the survivors, and the active species present, are of the greatest scientific interest. For example, some microbial growth is indicated at times in saturated salt muds, in which certain halophilic bacteria deteriorate the starch in spite of the high saline content of the fluid. While Rogers [4] states that, in the experience of the drilling industry, a 20% salt concentration in a drilling fluid is adequate for the protection of the fermentable colloids which it may contain, still it is not unreasonable to suspect that at times species of bacteria may be encountered which can survive and flourish at much higher concentrations. For example, Zobell, Anderson, and Smith [7] (1937) isolated from the waters of Great Lake—which has an average salt concentration of 27.5% sodium chloride—a species of bacteria which could only survive at high levels of salinity in its substrate, and would rapidly die off at low levels. One of these species isolated by Baumgartner [9], Bacterioides *halomophilus*, forms gas from starches and sugars, and might well be encountered in high-saline drilling muds. Not only have halophilic bacteria been encountered in high saline waters in nature, but Rappin [3] isolated, from both crude and refined salt, species of bacteria responsible for the deterioration of butter and cheese.

Bacteriological literature does not reveal instances of the adaptation of microörganism to high pH levels of the range of 11.5 and 12.0, and it would be safe to assume that rarely, if ever, would there be deterioration in drilling fluids maintained at those levels.

The versatility of starch, with its ease of handling as well as its flexibility, has been previously commented upon; and Rogers [4], in his revised edition (1953) of his book, *Composition and Properties of Oil-Well Drilling Fluids*, states that, "Starch is used to control fluid loss in all kinds and types of muds except oil-base muds." So general is the use of starch in the industry that the latest estimates indicate as much as 50,000,000 lb are now used annually in this field during a normal year of operations. It seems strange, therefore, that more attention has not been devoted to improving the one quality which is lacking in starch for drilling purposes, and that is in making it resistant to microbial deterioration by some procedure and technique which would not place it on a price level with the more expensive products such as CMC and the acrylates, but at a small additional cost endow it with "a built-in" system of protection. It seems to the writer to be a too useful instrument in the hands of the drilling companies to remain unimproved as regards its vulnerability. While much has been reported in the literature on the effectiveness of drilling starches in the laboratory and the field when properly protected by the nature of the substrate to which it is applied, or in the presence of externally applied germicides, there are but few data on the rate of deterioration of the best starches under conditions of contamination with a bacterial population of high potency, unprotected by bacteriostatic or bactericidal agencies. In Table I are some tabulated data from the results of our extended investigation of this problem.

Table I

Example No. 1—Type of mud: fresh-water; 6% clay; mixed: 20-min high-speed mixer; aged overnight; 1 lb per bbl starch added; aged for 8 hours before testing for water loss.

No.	Treatment	Initial Water Loss 30 Minutes	Water Loss After 2 Weeks (Cubic Centimeters)
1	Control	4.9	14.08
2	Control	4.6	13.00
3	Control	4.8	16.00
4	Control	4.8	13.00
5	Control	3.6	11.00

All of the above fluids were inoculated

* Wm. L. Owen Laboratories, Baton Rouge, La.

with 3% by volume of a culture from a fermenting mud suspension.

It will be noted that the deterioration rate as measured by the accelerated water loss of the mud averages from an initial 4.2 to a loss after deterioration on incubation for two weeks of approximately 12.0 cc, with a maximum increase of approximately 11.00 cc. In practice in the field, starch is always protected by added salt, or by adjusting the pH of the mud to a level of approximately 11 pH, as the following examples show.

In many of these inoculated muds with the added starch, vigorous fermentation could be observed in a few days after the samples had been placed in an incubator.

That the starch under the above conditions should have lost its effectiveness so completely within two weeks would not appear at all surprising either to bacteriologists or to experienced oil-well drilling technicians.

Conventional methods of protecting starch in drilling fluids by the addition of extraneous preservatives, are frequently more costly than the water loss inhibitors added. Even at saturation points, the fluids are not always rendered bacteriostatic.

The weight of caustic required to preserve the starch may be one-half to two-thirds that of the starch itself.

Under these conditions, one might well wonder why some effort has not been made in the past to build into drilling starches the necessary properties for their preservation while in use in the wells. Aside from the reference to the suggestion contained in Cannon's paper [8] that these starches should be chlorinated, little is mentioned in the technical literature on this important phase of starch immunization against deterioration by the zymogenic activities of microörganisms.

A study of the characteristics of starch, and particularly its absorptive properties, led us to believe that it could be reacted with some bacteriostatic agent, at no considerable cost, which would endow it with the properties sought for. With this in view, we began a series of tests of well-known preservatives, the most important of which were, ortho benzyl parachlorphenol, propyl-parahydroxybenzoate, iodized starch, and methyl parahydroxy benzoate. These materials were applied to the starch in alcoholic solutions, using 95 to 98% isopropyl alcohol as the solvent. The starch was then dried in an oven at 60°C. and then applied to drilling fluids made up of 6% clay and water. Initial tests were made of the water loss of the samples, and duplicate samples of drilling fluid were then placed in an incubator after being inoculated with 3% of a fermenting mud from an oil field. The results of this test are shown in Table II.

When Ortho-benzyl Parachlorphenol is reacted with the starch so as to give a 5% addition, the 1.7% of the starch in the mud which corresponds to 6 lb per bbl, the percent concentration of the preservative based upon volume is equivalent to 0.085%; but it will be noted that, when this concentration is established extraneously (or in the drilling fluid), the water loss after two weeks has increased from 4.8 on the control to 6.2 for the starch in the extraneous method of application.

Table II

Comparative Efficiencies of Substances When Used Extraneously and When Reacted with the Starch Ortho-benzyl Parachlorphenol (Santophen)

Samples Reacted Starches Received
5% by Weight of Preservatives in Alcoholic Solutions

Substance	Pounds Starch Per Barrel	Reacted	Initial Water Loss (Cubic Centimeters)	Water Loss After Two Weeks (Cubic Centimeters)
1. Control	6.0		4.0	17.00
2. Ortho-benzyl Parachlorphenol	6.0	With starch	4.8	5.2
2a. Ortho-benzyl Parachlorphenol (except 1% by weight of fluid added extraneously to mud)	6.0		4.0	6.2
3. Propyl Parahydroxybenzoate	6.0	With starch	4.0	17.0
4. Iodized starch	6.0	With starch	4.0	17.0
5. Methyl Parahydroxybenzoate			4.2	15.0

TABLE III

Two-Week Incubation of Inoculated Fluids

No.	Concentration OBPP Applied To Starch	% on Fluid	Pounds Starch Per Barrel	Washings From Treated Starch	Original Water Loss (Cubic Centimeters)	Loss After Two Weeks
1	5.0	0.08	6.00	—	5.6	6.0
2	Washed starch	—	6.00	30.00	5.6	12.5
3	Washings added extraneously	0.08	6.00	30.00	5.6	8.2
4	Control untreated starch	—	6.00	—	5.6	12.0
5	Washed triturated starch	—	6.00	5.00	5.6	10.0
6	Control starch washings added	0.08	6.00	5.00	5.6	12.0

This is true in spite of the fact that the concentration of the preservative in the solution is 16 times higher than when applied in the integrated form. Under our method of preparing and testing integrated starches for the oil-well drilling industries, we first prepare 1% concentration of the chosen bacteriostatic agent, which we have found to be the abovementioned Ortho-benzyl Parachlorphenol* in isopropyl alcohol 95%. This solution is then filtered over the starch in the ratio of 100 cc of alcoholic solution to 20 grams of the starch to be treated. After several repeated recyclings of the filtrate, the material is partly dried in a Buchner funnel under vacuum, and is then transferred to an oven where it is dried at a temperature of 60 C. The material can also be prepared by the application of the Ortho-benzyl Parachlorphenol in the form of an oil-emulsion preparation which can be applied directly to the starch, which is later dried.

Our results indicate that, when starch is treated with solutions of Ortho-benzyl Parachlorphenol in isopropyl alcohol and then dried, the bacteriostatic agent is fixed (or integrated) with the starch in a closely combined condition. If it were merely loosely held by absorption on the surface of the starch, then it could easily be washed off with isopropyl alcohol, or other solvents in which it is soluble. Here, again, we have found that, after the starch is once dried, the preservative is closely held, and that it is not easily washed off. Table III gives an example of the tenacity of this retention of the bacteriostatic effects of this preservative. In this experiment, a sample of starch was treated in the regular manner with Ortho-benzyl Parachlorphenol in a 1% concentration in isopropyl alcohol, and the rate of application of the solution was in the amount of 100 cc to 20 grams of the starch. After filtering off the excess alcohol, some of the material was dried, as above described, and the remainder was washed again with isopropyl which contained none of the preservative. After thoroughly washing, the material was then dried, and a comparison was made of the relative filtration values of the two products, together with an untreated control.

It will be noted that, of all the preservatives tested, only Ortho-benzyl Parachlorphenol had the property of rigid attachment to (or adsorption by) the starch to which it was applied.

In order to determine the comparative effectiveness of the Ortho-benzyl Parachlorphenol when integrated with the starch, and when applied extraneously thereto, the following experiment was carried out: A sample of our integrated starch was added to a drilling mud and placed into the incubator after inoculation with an active culture of fermenting muds bacteria. A similar amount of the same starch was washed and triturated with isopropyl alcohol, then redried and applied to a similar portion of fluid, as in the first instance. To a third jar containing untreated starch, these washings from the above were added to the fluid, and it was assumed that these washings contained all of the Ortho-benzyl Parachlorphenol which had been adsorbed by the treated starch. In order to effect a complete removal of the adsorbed preservative, the starch was thoroughly triturated with the alcohol in a mortar during the washing process. The results of a two-week incubation period of these inoculated fluids are shown in Table III.

From the results in Table III, we may draw the following conclusions:

1. That the integrated starch impregnated

* USA Patent Application Serial No. 663,865, dated June 6, 1957.

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with OBPP in the usual and prescribed method does not deteriorate within two weeks' incubation.

2. That the same starch when washed and triturated with isopropyl alcohol deteriorates rapidly under these conditions.

3. That the OBPP of the adequately protected treated sample, when applied to the drilling fluid extraneously, in the form of the washings as obtained under the treatment described, does not offer any detectable protection to untreated starch in drilling fluid.

4. In the light of the above, we can only conclude that the great virtue of the integrated OBPP, as a protection against the deterioration of starch in drilling fluids, is that it is held tenaciously by adsorption upon the surface of the starch grains.

In the previous experiments, we were applying the preservative at the rate of 50% of the weight of the starch, and in a 1% solution in isoproyl alcohol. This concentration had previously been determined by test.

In order to determine the level of bacterial populations in deteriorating drilling fluids, a series of tests was run of inoculated muds containing starch, and plate counts made of the samples at successive intervals. The results of a series of these tests are shown in Table IV.

It will be noted from the data in Table IV that the bacterial population increases rapidly after inoculation, and continues to increase throughout the first four days thereafter, but falls rapidly after this period. The water-loss values increase parallel with the increase in bacterial concentration in the fluid.

A similar test was made of inoculated muds containing our treated starch—the samples being inoculated and incubated in an identical manner as described in the previous test. The results of these tests are shown in Table V.

Table V

Treated Starch

No.	Days Incubated	Water Loss at Same Interval	Bacterial Population (Number of Cubic Centimeters)
1	Initial	4.8	110,000
2	After 1 week	5.0	993,000
3	After 2 weeks	5.2	808,500

The curve of bacterial growth in these samples is greatly different from that of the fluids containing untreated starch; for, in the latter case, a concentration of over 13 million bacteria per cubic centimeter was established within a period of three days, while with the treated starch the count, even after two weeks, was less than one million. The deterioration of the fluid ran parallel to the growth curve of the bacteria, and it will be noted that the limit of deterioration of the fluid containing the untreated starch had been reached in approximately two days at the time when the maximum concentration of bacterial population had been attained. In the treated starch, no appreciable deterioration had occurred within two weeks, and the number of bacteria per cubic centimeter was below one million cells per cubic centimeter.

It is quite likely that the degradation of starches in drilling fluids is induced by the enzyme diastase secreted by the microörganisms developing in the substrate containing added starch. This is to say, the cause of the deterioration is microbial in origin, but the instrument by which this change is induced is by the action of amylase secreted by the bacteria developing in the fluid. In order to test the rate of degradation of starch in drilling fluid by the presence of diastase, the following experiment was carried out:

A fresh-water drilling mud was prepared; and starch was added, at the rate of 6 lb per bbl, to each portion of 300 cc. An active preparation of Taka diastase was added in varying amounts to the series of fluids, and toluene added to each portion in the concentration of 2% by volume. Each of the jars containing the fluid was stoppered with a loose-fitting cap and then placed in the incubator, where they were stored for a two-week period before testing. As it is reasonable to assume the deterioration of the starch in the fluid is induced by amyolytic enzymes secreted by the microörganisms contained in the flora of the inoculating material, the effect of the diastase should follow the pattern of deterioration which we have shown to be typical of our inoculated samples. The results of this test are shown in Table VI.

It will be noted that, when as little as 1 cc of diastase is added to the 300 cc of fluid containing the unintegrated starch, the latter is completely deteriorated within a two-week incubation period. And even when the same concentration of OBPP which is incorporated with the starch is added extraneously, deterioration proceeds at practically the same rate as that of the control (unprotected) starch. On the other hand, even with 5 cc of diastase added to the fluid containing the integrated starch, the deterioration is only nominal, and the fluid is still usable after two-week incubation period.

There is some reason to believe the effectiveness of the OBPP, when integrated with the starch, is to be attributed to its inhibition of the diastase-secreting powers of the microörganisms ordinarily responsible for the deterioration of unprotected starch in drilling fluids. This may be explained by the reasonable assumption that the amylases or diastases secreted into drilling fluids by the usual microflora of these substrates are *adaptive* rather than *constitutive;* and while essential to the life activities of the microörganisms secreting them, are produced only when the nature of the substrate upon which the species are growing contain the substance which the enzyme is capable of attacking. For example, it has been found that some bacteria secrete diastase only when grown on starch-paste substrates, and never when starch is absent. It will be seen, therefore, that when OBPP is integrated with the starch, the characteristic of this carbohydrate, so far as its enzyme-secreting stimulating property is concerned, is lost; and that the adaptive secretion of diastase is inoperative.

When externally applied, we have encountered some deterioration of untreated starch when a concentration of as high as 1% has been established externally; but, aside from the economy and the greater efficiency of the integrated material, the saving in labor is quite an inducement to use the starch with the "built-in" protection.

There is another advantage in the exclusive use of integrated starch for drilling in fresh-water systems, or wherever fermentation may be a problem, and that is to avoid the trouble at its inception rather than after it has already begun. For example, Rogers [10] states that, under rare conditions, a starch in fresh-water fluid may be applied in drilling without converting the system into either a high pH or saturated saline status, and without the addition of a preservative, but only for a short duration—so that the well may be completed before fermentation progresses too far. He also points out that even the application of these preservatives externally is not effective over a long period of time; and that, if the well is

(*Continued on page 77*)

Table VI

Deterioration of Drilling Fluids

Untreated starch: 6 lb per bbl; counts made at various intervals; nutrient agar substrate

The density of the bacterial population in drilling fluids containing starch at different stages of deterioration

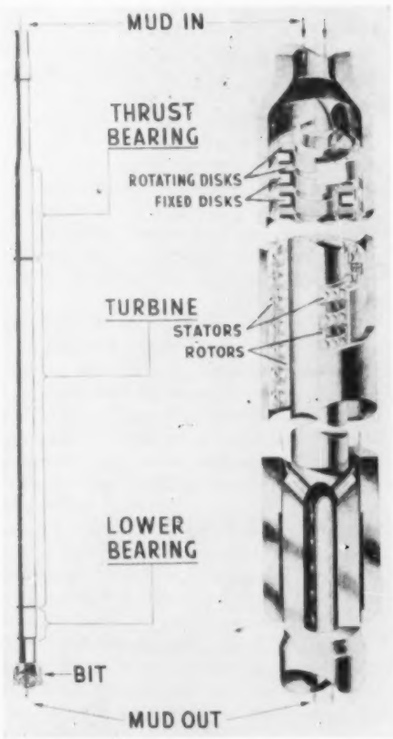
No.	Treatment	CC's Diastase Added	Pounds Per Barrel Starch	Initial Water Loss in 30 Min (Cubic Centimeters)	Final Loss After Two Weeks (Cubic Centimeters)
1	Control untreated starch	1	6	4.6	13.5
2	Control untreated starch	2	6	4.6	14.0
3	Control untreated starch	5	6	4.6	12.0
4	Integrated with OBPP 0.250 grams to the starch	5	6	4.6	7.6
5	Control starch 0.250 grams added extraneously and to the solution	5	6	4.6	11.5
6	Control starch	10	6	4.6 (3 days)	9.0

No.	Days Incubated	Water Loss at Same Intervals	Bacterial Population (Number of Cubic Centimeters)
1	Initial count	4.8	115,000
2	Count after 4 days' incubation	10.5	13,400,000
3	Count after 8 days' incubation	11.0	519,500
4	Count after 14 days' incubation	11.0	660,000
5	Count after 18 days' incubation	14.0	986,000

Active search continues to improve drilling techniques

Percussion, sonic, and turbodrill studies continue. Turbine-powered wheel drill is proposed; air-drilling applications are widened by new grouting fluids and foaming agents.

Major elements of a turbodrill.



THE past year has not seen a major breakthrough in the technology of drilling, but there has been continued improvement in rate of penetration due to better equipment and better controls available to the driller.

It should not be assumed the industry has not been active in the search for a new drilling method to supplant the conventional rotary. Development has gone ahead at a rapid pace in study and testing of the turbodrill, and of modern versions of the percussion drill.

A variant of the turbodrill now being tested is known as the "wheel" drill. It consists of a diamond-faced cutting wheel powered by a drilling-fluid turbine. Results obtained on tests with this type of bit have not been published. It has been suggested the employment of such a bit would permit very high rotation speeds, but that a high degree of accuracy in weight control and feedoff might be essential to success. It is assumed the bit would be most successfully employed in special types of rock, as is the case with the conventional diamond bit.

The hammer drill announced a year ago by Gulf Research & Development Co. is now considered semi-commercial. A supply of bits manufactured by Continental Emsco has been put into the field for commercial use. This bit is a mud-operated percussion device operated on a low frequency. In it, the power is delivered to a bit anvil by a reciprocating hammer. Unlike earlier churn drills, the entire tool is not reciprocated. Gulf now is developing a modification of the bit with a positive-drive dual hammer. This latter design still is considered to be in an experimental stage.

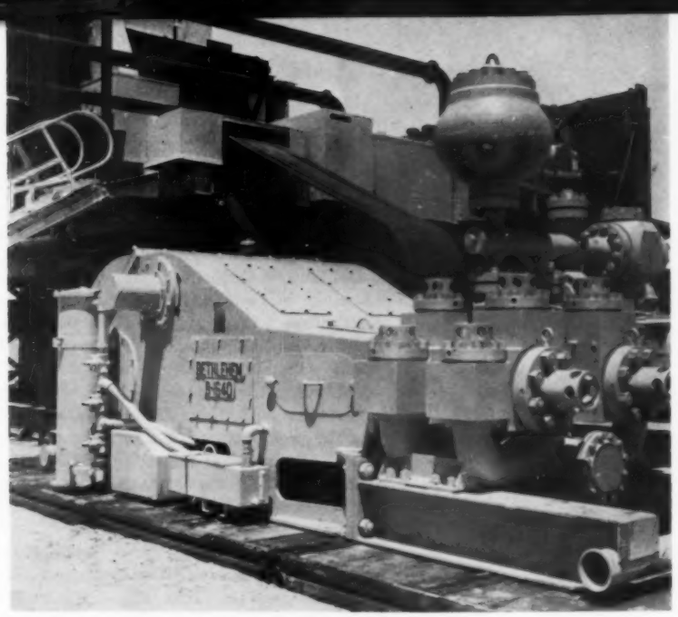
Gulf was led to undertake its hammer drill research several years ago because of the slow drilling rate in West Texas chert where rates as low as ½ ft per hour were then common. In laboratory work drilling in granite, the research workers came to the conclusion that the percussive effect was the product of impact force and frequency. When the bit was taken into the field, it was found that penetration rates were more than doubled with weight on the bit at 40,000 lb. Much greater increases were attained at lower bit weights. Gulf feels its hammer drill can increase footage per bit, increase penetration at lower weights and, hence, save drill collars and trip time.

The sonic drill under development by Borg-Warner is vibrated at 60 to 90 cycles per second—far faster than the other percussion-type drills—and is operated by a mud turbine. Work on this has been in progress for several years, concurrently with the magneto stricture drill sponsored by a cooperating group of oil companies.

The Turbodrill Division of Dresser Industries Inc., Dallas, recently completed a test stand capable of handling all sizes of turbodrills. It can produce bit weights up to 100,000 lb, and circulate up to 1,000 gpm. The stand is completely instrumented for accurate study. The test stand is supplemented by field testing of new designs and techniques.

Proponents of the turbodrill as a drilling method of great promise point out that horsepower delivered to the bit is much greater than in the case of rotary, and that transmission losses may be reduced even further by increasing the diameter of the drill pipe. Principal current difficulty with the turbodrill is with the inability of off-the-shelf bits successfully to transmit the turbodrill's horsepower to the formation, according to a paper on turbodrills presented before the spring meeting of the Eastern District of the API Division of Production at Columbus, Ohio, early in May, by J. A. Mitchell.

Discussing present-day Turbodrills, he said that modern turbodrills have evolved after some 30 years of development into simple, multi-stage, fairly low-speed, mud-



Bethlemen heavy-duty mud pump for deep-well work installed on R. J. Sharp Drilling Co. rig near Kermit, Texas.

Rotary power swivel developed by Baash-Ross.

operated turbines. Essentially, they are constant-flow variable-speed machines. From a mechanical design standpoint, they are quite rugged, and certainly can be considered as an oil-field tool. Two basic types of turbodrills are now available. These are the standard 100-stage unit; and the tandem drill, made up of two or three standard sections and containing from around 200 to 240 stages. Each of these models is available in several sizes.

"There has been much discussion about the bearings in turbodrills. However, these simply are rubber bearings operating against a steel wearing surface, just as in the 'Cutless' bearings which have been with us for many years. Most turbodrills are about 30 ft long, with a shaft which is about 20 ft long. In order to prevent excessive whipping of this long shaft, there are intermediate radial bearings.

"Life of the various elements of the tool is quite good, and maintenance is not too serious a problem. The turbine blading has a life of somewhere between 1,000 and 3,000 hours, depending on the operating conditions. Flow velocities through the turbine blading are on the order of 20 to 40 ft per sec; and, when the drilling-fluid sand content is held below 3% or 4%, erosion is not a problem. The shaft and body of the turbodrill have lives numbering in the thousands of hours. Loads on the radial bearings are relatively small, and these bearings have lives numbering in hundreds of hours. The thrust bearing carries the highest operating loads of any element in the tool; but, with proper operating techniques, thrust bearings last from 140 to 200 hours.

"Considering bearing friction and other losses which would occur in actual drilling, the 6⅝-in. tool will produce 160 hp to 200 hp at the bit when circulating 600 gpm. Performance curves for the other sizes and models are similar in form to those for the 6⅝-in. Useful horsepower varies from about 40 for the 5-in. tandem tool to about 500 for the 10¼-in. standard tool. In actual drilling, speeds range from around 500 to 1,000 rpm.

"Handling of turbodrills is quite similar to handling drill collars. They are oil-field tools, and require no more care than that given to other down-hole tools. In the drill string, they are run immediately below the drill collars—with the bit attached to the lower end of the turbine shaft. Fewer drill collars are run with the turbodrill than in normal rotary drilling, for the following reasons:

"1. Less weight is used with turbodrills than with rotary.

"2. It is desirable to eliminate restrictions to mud flow caused by small drill-collar bores.

"Once the turbodrill passes through the rotary table, all other operations on the rig floor are the same as for rotary drilling. Upon reaching bottom, pumps should be started and run slowly to break circulation. Bit weight and pump speed should then be increased simultaneously, until operating conditions are reached. High-rate circulation for extended periods with the bit off bottom should be avoided. When off bottom with full circulation rate, the turbodrill rotates at high speeds, and bit shirt-tail wear is likely to occur. In addition, there will be excessive wear on the turbine thrust bearings. When making connections, or if the tool stalls, the pump speed should be reduced before lifting tool off bottom.

"Rotation of the drill string is not necessary when turbodrilling; however, it is normal practice to rotate the drill string slowly just to keep it in motion. Depending on conditions, this can be accomplished either through the rotary table in the usual manner, or by unlocking the table and allowing the torque of the turbine to rotate the pipe from the bottom of the hole. Rotation of the drill string at slow speeds, about 6 to 8 rpm, is desirable.

"Worn bits are usually evidenced by a noticeable drop in penetration rate. When the drill string is rotated from the bottom of the hole by the turbine, an increase in rotary speeds may mean a dull bit. Recurrent stalling of the turbine is also an indication of dull bits. Obviously, if penetration rate decreases sharply, or if the turbodrill does not appear to be functioning properly, a round-trip is in order.

"Except for the added necessity of measurement of turbodrill thrust-bearing clearance each time the tool is out of the hole, round-trips are accomplished in the usual manner.

"In the last year and a half of the development program, Dresser's turbodrills have drilled approximately 20,000 ft of hole in about 200 bit runs. The tools have proved to be excellent for combating crooked-hole conditions. In crooked-hole drilling conditions, turbodrill penetration rate is two to four times faster than that of comparable rotary.

"In the 30 field tests which have been conducted to date, a wide variety of drilling conditions have been encountered. The turbodrills, as down-hole motors, have performed very well. The average penetration rate has been between 2½ and 3 times that of rotary, while bit footage has ranged from 30% to 110% of rotary. In general, when penetration rates are 2½ times that of rotary and bit footage is at least 75% of rotary, the turbodrill will drill cheaper than rotary. Obviously, if bit footage or penetration rate is increased, the saving with turbodrills is increased.

"At this time, bit performance is the critical item in the turbodrilling. Conventional rock bits, as good as they are, were not designed for the horsepower and speed of the turbodrills. Bits larger than 8¾-in. have performed very well, while the smaller bits leave something to be desired. A high degree of success has been experienced in

(Continued on page 68)

Offshore seismic exploration in the Caribbean area

75,000 square miles of continental shelf offshore from Caribbean sedimentary basins offer a promising region for exploration

by Henry L. Grant*

DURING the past two years emphasis in geophysical exploration has been focused more and more on foreign areas. This is true of offshore seismic operations as well as of land operations.

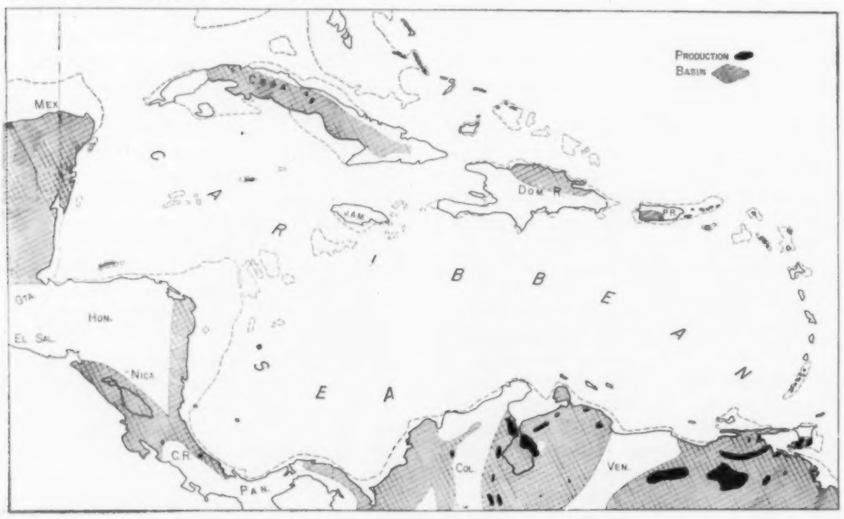
One of the offshore areas which has seen extensive activity is the Caribbean Sea. The offshore areas in and near the Caribbean which will be covered in this paper are shown in Fig. 1. The dashed line on the map represents the 180-ft water-depth line. The cross-hatched areas show the known sedimentary basins on the land masses bordering the Caribbean Sea, and those areas which are productive are shown in solid black. The nearby presence of some of the most prolific and most profitable oil fields in the world, along with large unexplored continental shelves, has encouraged offshore seismic exploration in the Caribbean.

There are approximately 75,000 square miles on the continental shelves offshore from the sedimentary basins shown on this map. This is an area 3½ times as large as the area offshore Louisiana.

The Gulf of Paria, between Trinidad and Venezuela, is considered one of the most promising regions in the Caribbean area. There are 3,200 square miles in the Gulf of Paria. It is about one-seventh the size of the Louisiana shelf. Offshore production has already been found near Trinidad, and there are oil fields very near the shore on the Venezuelan side of the gulf.

* Western Geophysical Co. of America, Shreveport, La. This paper was presented by Mr. Grant at the Dallas meeting of the Society of Exploration Geophysicists, and is published here with permission of Dr. L. Y. Faust, editor of *Geophysics* magazine.

Fig. 1. Offshore geophysical operations, Caribbean area.



The shelf off North Central Venezuela is about the same size as the Gulf of Paria, and the nearby onshore production enhances the potential of this area.

The Gulf of Venezuela, lying next to prolific Lake Maracaibo, should offer excellent possibilities for future oil production. The Gulf of Venezuela is one-fourth the size of the Louisiana shelf.

The sedimentary basins of Colombia and Panama, located along the shore, also indicate the possibilities of future offshore activity. A very good show of oil found in Costa Rica, near the coast, has encouraged activity offshore Panama, Costa Rica, and Nicaragua.

The shelf off Nicaragua and Honduras is larger than the shelf offshore Louisiana, and should see considerable offshore activity. Offshore Guatemala and British Honduras are areas also considered possible for offshore production.

Oil production in Cuba is negligible, but it does indicate that the northern and southern shelves off Cuba are prospective areas for future oil production. One large well is being drilled offshore Cuba.

Fig. 2 shows those offshore areas where some seismic work has been done.

One factor which must be considered in planning efficient offshore operations is weather. This is particularly true in the Caribbean, where storms are violent and safe ports sometimes far from operations.

Fig. 3 shows the hurricanes which have occurred in this area during a 20-year period. They are shown by months. As can be seen, it is difficult to take evasive action, for they originate in all parts of the area and travel in almost all directions. The months of August, September, and October have the most hurricanes and, therefore, should be avoided, if possible, in scheduling work which is far removed from port. This is also a problem of great concern in the drilling of offshore wells in this area.

The general weather conditions, dockage, and supply situations vary greatly from area to area. In the Gulf of Paria, Guiria, Venezuela, is used as an operating base for the Venezuelan part of the gulf; while Port of Spain, Trinidad, is used for the operations off Trinidad. Weather conditions are generally good here, and the seas are not too rough. Operations are somewhat tricky, however, at the northern and southern extremes of the Gulf of Paria, where the currents are quite swift. The area southeast of Trinidad is very difficult to work during December through April due to high seas and the absence of nearby port facilities.

In Barcelona Bay, docking facilities are at Puerto La Cruz. The weather here is good, and the seas are not too rough.

In the Gulf of Coro, the operations base is Punto Fijo. The seas in this area are very rough due to steady east winds and shallow water.

For work in the Gulf of Venezuela, the closest docking facilities are in Maracaibo or Punto Fijo. The seas are extremely bad in the Gulf of Venezuela due to tidal currents from Lake Maracaibo, plus prevailing

northeasterly winds which are funneled into the gulf by mountains on all sides. It is a challenge just to stay out and work in the rough seas of the Gulf of Venezuela. This is in direct contrast to work in Lake Maracaibo, where the seas are rarely rough.

Venezuela does not permit shots to be fired in water less than 17 ft deep. Therefore, a drill barge or a jetting boat is needed to work large areas in the Gulf of Paria, the Gulf of Coro, and near the beaches in all other Venezuelan coastal waters.

For the work offshore Panama in the Cherique Lagoon, docking facilities are good at Bocas del Toro, and the seas are not rough in these protected waters.

Port facilities are often poor in Cuba. It is sometimes necessary to dock at one town, pick up water at a second town, and pick up supplies at yet a third town. The principal operating problem around Cuba is one of navigating around and through shallow reefs.

In the Bahamas and on Caicos Bank, there are no docking facilities. The closest supply point to Caicos Bank is Cap Haitian, Haiti; and work in the Bahamas may be supplied out of Miami, Fla.

Line-of-sight electronic positioning control is used almost exclusively in the Caribbean area. This system is very satisfactory except when operations are conducted more than 20 or 25 miles from shore. In this case, target boats are often required—resulting in a substantial unit cost increase. In areas where mountains are present near the coast, the effective range of the line-of-sight system can, of course, be greatly increased.

The use of relatively shallow-draft boats, sturdily built of steel, is essential for Caribbean operations. In many areas, the boats will run aground on hidden reefs or shallow mud banks. The screws must be above the keel and fully protected, as repair facilities for boats are widely scattered in the Caribbean.

Now let us take a look at recording and interpretation problems in this area. Completely satisfactory results are difficult to obtain in many parts of the Caribbean. The presence of rough coral bottoms offered a real operations problem until the past two years. It was impossible to use bottom cables, and the dips were often too steep and the water too shallow to use the then available pressure-sensitive cables. The development of the highly sensitive pressure-type marine geophone and the depth-controlled floating cable solved most of these problems.

Among the more frequently encountered recording problems are the reflected water signals from the ever-present coral irregularities, islands, and often rugged shore lines. In some areas, this energy is so great that reflected energy is almost impossible to record from the sedimentary sections. Selective filtering and geophone spacing—combined with careful program planning—are often helpful, but are not always a satisfactory solution.

Speaking generally of the Caribbean area, a seismic crew is likely to encounter areas

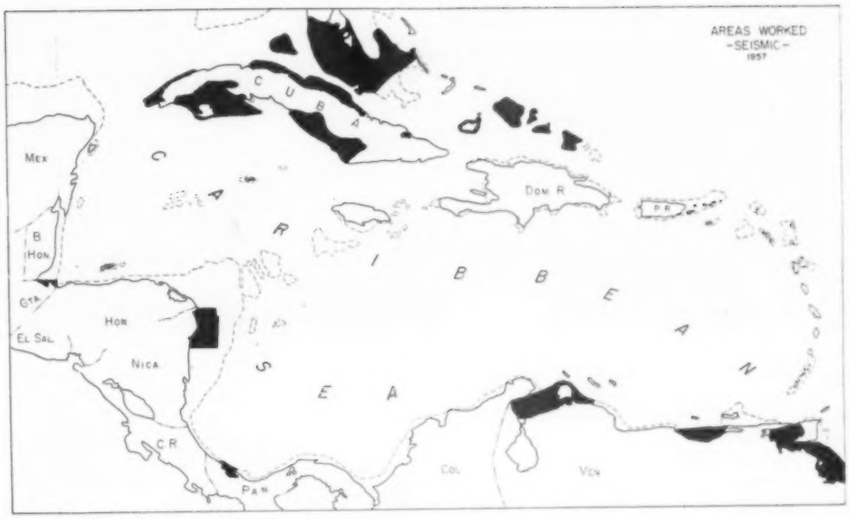


Fig. 2. Offshore seismic operations, Caribbean area.

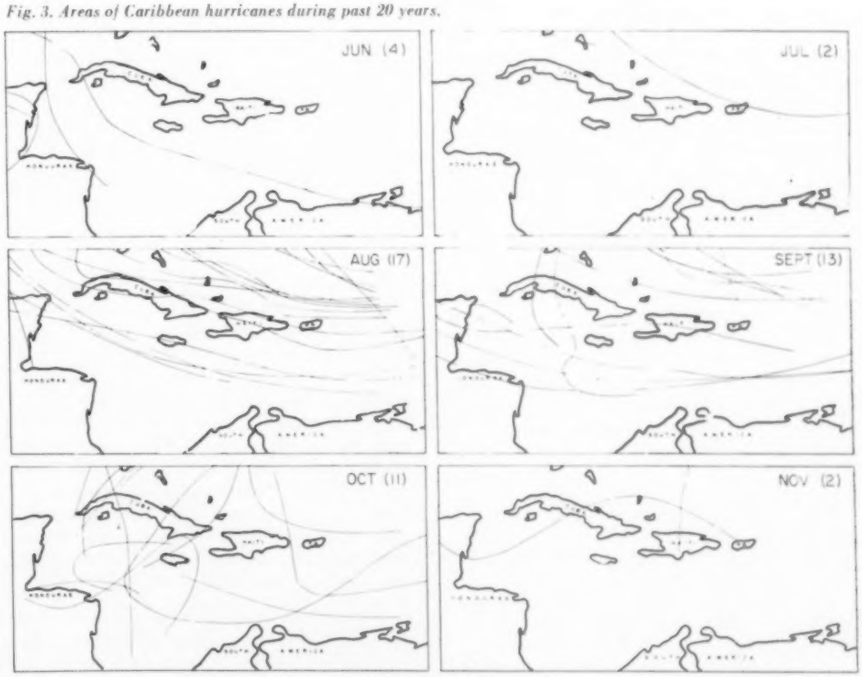
where there are thick sedimentary deposits, and areas where there are thin sedimentary deposits; areas of high velocity section, and areas of extremely low velocity section. In order to assure the best possible record, quality geophones, with a high output at both low and high frequencies, must be used. The seismic filters must be completely flexible, for very specialized filtering is often required.

Crews operating in the Caribbean should be able to switch from reflection to refraction shooting on short notice, as refraction surveys are often conducted in order to determine the thickness of the sedimentary section, to determine the throw of faults, and also to define intrusive domes.

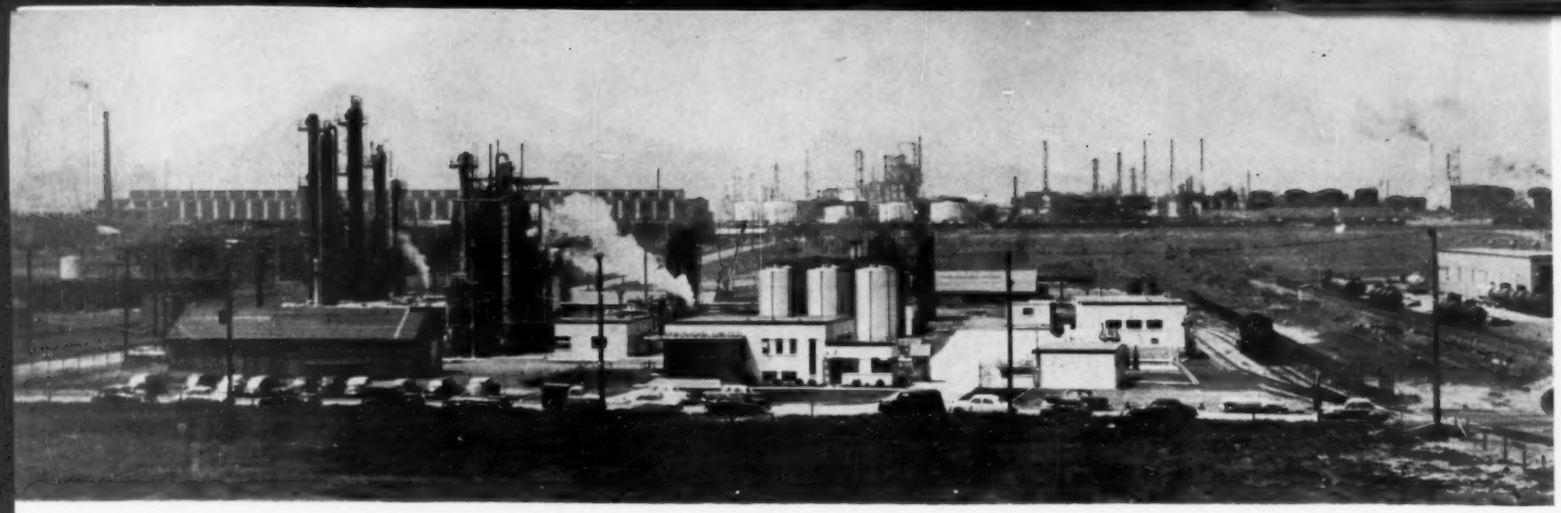
The Caribbean area in general is characterized by highly-faulted steep-dipping complex structures. The absence of subsurface control in many areas adds to the problem of evaluating structures. Record sections are an invaluable aid in helping to solve the complex geophysical, geological, and structural problems encountered in the Caribbean area.

The intriguing geology of the Caribbean region, the size of the various continental shelves, and the geophysical challenges which have been met successfully have led to an active offshore program in the area during the past two years, and point to additional successful exploration programs in the future. END

Fig. 3. Areas of Caribbean hurricanes during past 20 years.



HURRICANES BY MONTHS



Phenol-from-cumene plant operated by B. A. Shawinigan Ltd., at Montreal East, Canada (photo courtesy Shawinigan).

Petrochemical horizons for propylene Part II: Acetone as coproduct of

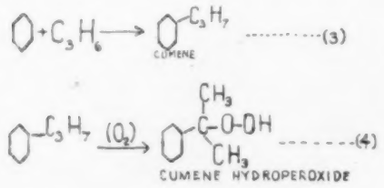
(a) Phenol
(b) Hydrogen Peroxide
(c) Allyl Alcohol

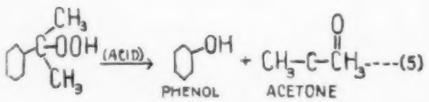
by Peter W. Sherwood*

II (a) Acetone as Coproduct of Phenol

SINCE 1953, a new source of acetone has offered competition to the isopropanol-acetone route (described in Part I of this series) and to the nonspecific partial oxidation of propane and butane. The new method has as its primary purpose the production of phenol, but some 61 lb acetone are formed as coproduct with every 100 lb of phenol output.

In the process, propylene and benzene are the starting materials. As first step, cumene is formed. This intermediate is then air-oxidized to cumene hydroperoxide which can be split to phenol and acetone:





This process has found rapid acceptance. In the five years since its commercial debut (at B. A. Shawinigan's Montreal plant), the cumene hydroperoxide route to phenol and acetone has been adopted by three USA producers (Allied, Standard Oil Co. of California, Hercules). Their combined installed capacity is estimated at 90 million to 95 million pounds per year phenol, and at least an additional 30 million pounds per year plant capacity is currently under construction. Outside the United States, no fewer than six manufacturers have chosen the cumene-hydroperoxide route to phenol.

All told, this process already accounts for a significant portion of phenol and acetone production. In 1956, cumene hydroperoxide plants in the USA produced 93.8 million pounds phenol, or about 17% of that year's total output. Coproduced acetone accounted for 8% to 9% of USA production in 1956.

The production of 93.8 million pounds phenol by the CHP route consumes about 79 million to 80 million pounds cumene. This is 50% of total USA cumene output in 1956. In terms of propylene consumption, we may estimate that the production of phenol and acetone in 1956 accounted for 28 million pounds.

The economic value of the CHP process is controllingly influenced by the price structure of both phenol and acetone. So far, acetone has been the weaker member of the pair; as we have seen in Part I, the acetone market has shown only a slight growth trend in recent years, and its future expansion outlook is only moderate. Indeed, the market has been hard-pressed to absorb the incoming petrochemical acetone capacity, and an internal readjustment has occurred—largely at the expense of fermentation acetone, which has proved to be noncompetitive in the long run.

*Chemical Engineer, White Plains, N. Y.

Phenol, on the other hand, has shown lusty growth during the 1950's. USA production rose to 550 million pounds in 1956 from 388.4 million in 1951, and the prospect is for a 1961 output of 750 million to 800 million pounds. To be sure, alternative manufacturing processes (via sulfonation or chlorination of benzene) continue to be attractive sources for phenol, and capacity of this type has been built since the CHP process first arrived on the scene in 1953. However, the newer method has been definitely favored for recent phenol expansion. In all likelihood, this preference for the petrochemical cumene-hydroperoxide process will continue—barring an unforeseen major decline in the acetone market.

Market trends and outlets for acetone have been discussed in this article's previous installment. Because the role of the CHP process as a source for acetone—and consumer of propylene—is integrally tied to phenol economics, a short discussion of that commodity's market aspects is in order.

The foremost demand for phenol is in the manufacture of phenolic resins. 1956 production of these materials was 510 million pounds, and consumed an estimated 330 million pounds phenol, i.e., 60% of total output.

Phenolic resins have been on the market for nearly 50 years. By now, their use areas are fairly well established, and most of the growth momentum is spent. There is today no known development close to realization which might bring important new expansion to phenolics; their growth is, therefore, governed principally by the development of the economy as a whole.

In second position among phenol consumers is the synthesis of miscellaneous chemicals. Here, the production of 2,4-D and related weed killers is in the lead. This group of chemicals has shown a strong growth trend. Phenol consumption in its manufacture has risen from its beginnings in 1944 to 28 million pounds in 1956.

Strongly on the uptrend is the manufacture of *bis*phenol-A, a condensation product of phenol and acetone. This compound is used in the production of epoxy resins, as well as of polycarbonates, a new class of plastics. *Bis*phenol-A production currently consumes about 10 million pounds per year phenol, and is expected to use three times this amount by 1962.

Other important chemical derivatives of phenol include acetyl salicylic acid (aspirin), pentachlorophenol, and picric acid. The most important of these—acetyl salicylic acid—has a current annual production volume of 13 million to 14 million pounds, and utilizes an estimated seven million pounds per year phenol. This chemical, too, has passed its period of maximum growth; its output rises at the average yearly rate of 400,000 to 500,000 lb per year.

Some 8% to 10% of phenol production enters the trade as such. The principal application of this type is as solvent in extraction processes employed in petroleum refining. The compound is also used as disinfectant, as addition agent in copper-plating, and in numerous minor applications —including leather and textile dyeing.

As a source of phenol, the cumene-hydroperoxide process competes with recovery from coal tar and with three commercial syntheses. Actually, production from coking operations is today of minor importance (6.4% of total phenol output in 1954). The amount available from this source is intimately related to the extent of coke production, and is thus ultimately a function of activity in the relatively slow-growing iron and steel industries.

Of the three alternative methods of phenol synthesis, two involve the intermediate production of chlorobenzene. Volumewise, the leading process calls for substitution reaction of chlorine with benzene. Product chlorobenzene is converted to sodium phenate by high-temperature hydrolysis in alkaline solution.

An alternative approach is the raschig process, which is employed by one USA producer. This method calls for catalytic benzene chlorination by HCl in the presence of air. Chlorobenzene, obtained in this manner, is subsequently hydrolized to yield phenol and recycle HCl.

Sulfonation processes are employed by four American producers of phenol, and this approach is particularly suitable for relatively small plants. In this type of synthesis, benzene is reacted with sulfuric acid to yield benzene sulfonic acid—which is subsequently neutralized and then subjected to alkaline fusion, to yield the sodium salt of phenol.

These, then, are the processes with which the cumene-hydroperoxide process must compete in the manufacture of phenol. Public statements have repeatedly been made, ascribing to the CHP route the advantage that its only raw material is benzene (propylene is charged against acetone production). However, this benefit must not be overrated. The same statement can be made of the raschig process which has, nevertheless, remained a minor contributor to phenol output, due largely to severe and costly technical difficulties.

Also, the CHP process is credited with low plant investment cost per unit capacity. However, a full comparison of different phenol processes must include the cost of cumene production, and overall costs of the major methods of synthesis are not too far apart. The key to CHP process economics is the price which can be realized for coproduct acetone. The current outlook for this commodity is still sufficiently stable to make the cumene-hydroperoxide process a highly attractive route to new phenol capacity in most industrial areas.

Technical Aspects of the CHP Process: The first step in the production of phenol and acetone via the cumene-hydroperoxide route is the manufacture of cumene by the reaction of benzene with propylene.

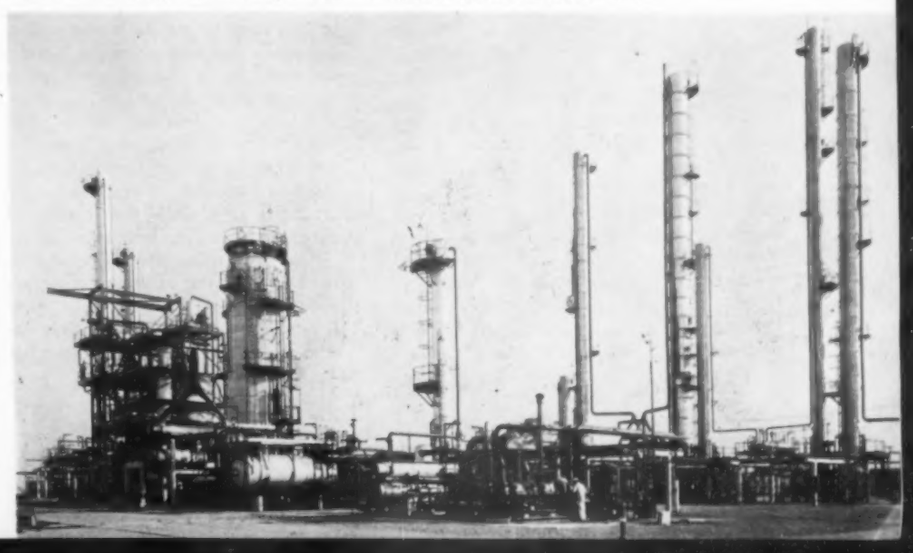
Three methods are employed commercially to carry out this alkylation: (1) vapor-phase reaction in the presence of phosphoric-acid catalyst; (2) sulfuric-acid-catalyzed reaction in the liquid phase; and (3) aluminum-chloride-catalyzed reaction in the liquid phase. The first two methods have seen long service in the United States, and were used extensively during World War II to manufacture cumene for aviation gasoline. The use of anhydrous aluminum chloride in cumene synthesis has been practiced in Europe, and has been in use at Allied Chemical's CHP plant at Frankford, Pa., since 1954.

A commercially successful method for vapor-phase isopropylation of benzene has been developed by Universal Oil Products Co. In this process, the catalyst is phosphoric acid on kieselguhr. In employing this catalyst, it is necessary to introduce about 0.1% by weight of water (either as such or, preferably, in the form of isopropanol) with the feed, in order to avoid premature loss of activity due to dehydration.

Benzene-propylene feed ratio is preferably held at about 5.0. At this molar ratio, cumene concentration in the (benzene-free), alkylate is 90%. At lower ratios, an excessive yield loss occurs due to the formation of polyalkylated benzene.

The reaction is normally carried out at 270 C, and at pressures between 250 psi and 400 psi. A liquid hourly space velocity of 2.5 is typical, but is varied as a function of temperature, pressure, and activity of the

Oronite Chemical Co. phenol-acetone plant, Richmond, Calif. (photo courtesy Oronite).



catalyst which declines with advancing on-stream life.

In the vapor-phase alkylation process, propylene is preferably used in concentrated form in order to permit operation at the lowest feasible overall pressure. Propylene is converted on a once-through basis, while unconverted benzene is recovered from the alkylate and is recycled to the alkylators. Overall cumene yield in the process is of the order of 90% to 93%, based on benzene.

Compared to vapor-phase alkylation, operation in the liquid phase has the chief advantages of permitting operation with more dilute olefin feed and at lower pressure and temperature. Furthermore, somewhat better yields, at least theoretically, are possible. These advantages are procured at the cost of corrosive conditions and of greater catalyst consumption.

These disadvantages have been brought well under control by virtue of extensive experience accumulated in both the ethylation and isopropylation of benzene, and the bulk of postwar expansion in these fields has been based on liquid-phase alkylation processes.

In the production of cumene, 88% to 90% sulfuric acid is an effective catalyst; about one volume is used in the reactor per volume hydrocarbon. Isopropylation of benzene with this catalyst is carried out in a manner similar to the alkylation of alkanes —which has found widespread application in refinery practice.

The preferred approach calls for two or three alkylators in series, and employs split olefin feed. This permits a tolerable overall benzene-propylene ratio of five-to-six, while the internal ratio of these reactants is substantially higher, and thus supresses the formation of polyalkylated benzene more effectively than is possible in vapor-phase synthesis.

Typical operating temperature in sulfuric-acid alkylation of benzene is 35 C to 40 C. Pressure is controlled at about 165 psig to maintain propylene in the liquid phase. Residence time is 30 min to 35 min in each of the alkylators.

The alkylate is depropanized, and is then freed of unconverted benzene, which is recycled. The crude alkylate contains, on a benzene-free basis, about 95% cumene—which is readily purified by fractionation.

Overall yield in the sulfuric-acid-catalyzed process is reported at 92% to 95% on benzene, and approximately 90% on propylene. Sulfuric-acid consumption is about one volume per 10 to 12 volumes crude alkylate.

A highly effective, but more expensive catalyst for liquid-phase alkylation is anhydrous aluminum chloride. This catalyst serves extensively for the ethylation of benzene to yield ethyl benzene (intermediate in the production of styrene). Its use in cumene synthesis is, however, more limited.

Aluminum-chloride-catalyzed isopropylation of benzene can reportedly use an LPG feed stock containing as little as 40% propylene—although this is achieved at correspondingly greater burden on alkylator volume. An important advantage of aluminum-chloride catalysis is the ability of this catalyst to disproportionate diisopropyl benzene in the presence of benzene to yield two moles of cumene. This permits the attainment of particularly high yields which are achieved by recycling a portion of the polyalkylate to the converters.

Conversion of Cumene to Cumene Hydroperoxide: The oxidation of cumene to its hydroperoxide is effected by molecular oxygen. The reaction is mildly exothermic (328 Btu per pound cumene hydroperoxide formed). It is carried out in liquid phase.

In attempts to oxidize pure cumene, a lengthy incubation period is observed. This is avoided by introducing peroxides with the feed, which act as reaction initiator. Since cumene hydroperoxide, the reaction product, is itself an effective initiator, the incubation period is eliminated in continuous reactors in which at least 3% of the oxidation product is present at the feed point.

Once the reaction has started, it proceeds at fairly constant velocity until cumene-hydroperoxide content exceeds approximately 40%. However, this rate, too, is quite slow—ranging from 3% to 7% per hour.

Even this rate can only be maintained by assuring the absence of inhibitors from the hydrocarbon feed. Most objectionable among these contaminants are sulfur, phenol, styrene, and alpha-methyl styrene. The three last-named compounds are formed in the course of the oxidation reaction, and must be carefully removed from recycle cumene.

Determining the conversion rate is the technique which is employed in carrying out the oxidation rate. The highest reported rate is a formation of 11% to 13% by weight of cumene hydroperoxide per hour. This is obtained in the oxidation of cumene at 120 C in the presence of metallic copper which has been pretreated with nitric acid. It appears, however, that this good performance is not easily reproducible, and the method has not found commercial application. Reaction rate obtained in commercial oxidation techniques is between 5% and 7% per hour.

Of industrial significance is the emulsion technique for cumene oxidation. In this process, cumene is emulsified with an alkaline aqueous phase which is controlled at a pH between 8.5 and 10. The mixture is thoroughly agitated throughout the period of oxidation by air. To promote even more intimate contact between the liquid phases, an emulsifying agent—such as sodium stearate—is employed.

Satisfactory rates may also be obtained in the absence of an aqueous phase by introducing an oil-soluble amine with the feed.

These autocatalytic processes call for operation at 110 C to 130 C and sufficient pressure to insure maintenance of a liquid phase. A member of commercial installations execute the oxidation in several successive stages at progressively lower temperatures (e.g., 120 C in the first stage, 115 C in the second, and 110 C in the third). In this way, the highest temperature—which permits the greatest reaction rate—is employed in the early stages where cumene-hydroperoxide concentration is low and its decomposition is not yet a serious factor. Overall conversion per pass is taken at about 25% in commercial practice in order to take advantage of the higher rate which prevails below this point, and also to minimize the occurrence of yield-destroying side reactions.

The product leaving the oxidation reactors contains about 65% to 70% unconverted cumene. Following separation of associated water, the bulk of this hydrocarbon is topped off, purified, and recycled to the reactor entrance. The crude concentrate contains 75% to 85% cumene hydroperoxide, together with unremoved cumene and acetophenone, dimethyl phenyl carbinol, and alpha-methyl styrene. This stream is fed, without further purification, to the decomposition reactors' feed tanks.

From Cumene Hydroperoxide to Phenol and Acetone: The fission of hydroperoxide to phenol and acetone proceeds rapidly in the presence of strong acid. Adequate cooling means must be provided in the decomposition converters to dissipate the highly exothermic heat of reaction (114,700 Btu per pound-mole).

Sulfuric acid is employed universally to catalyze the peroxide decomposition. In one version of the process, dilute (approximately 10% sulfuric acid is brought into intimate contact with the feed stock by thorough agitation.

More recent methods call for the use of either phenol or acetone as homogenizer of the reaction system. These methods make reaction efficiency less dependent on the efficiency of agitation, and also diminish the difficulty of product separation and purification.

The reaction is carried out between 45 C and 60 C, and at essentially atmospheric pressure. Yield on cumene hydroperoxide is reported to be 94% to 96% phenol and 95% acetone.

The crude decomposition product is a complex mixture of compounds. The first step in the recovery of the desired products is neutralization of the acids stronger than phenol. Subsequent purification of the product involves a series of extraction and distillation steps—the choice of which depends, above all, on the technique selected in the hydroperoxide splitting stage. Details of various methods for purification of phenol and acetone obtained in CHP processes have been reported by the author elsewhere.[1]

Overall, the cumene-hydroperoxide process provides phenol yield of 85% to 90%, based on cumene. Acetone yield is approximately the same. In addition to these main products, byproduct acetophenone and alpha-methyl styrene are recovered by at least one commercial operator of the process in the United States.

Note: *Balance of this article, i.e., on acetone as coproduct of hydrogen peroxide, and allyl alcohol will appear in a subsequent issue.*

there's more to Cities Service than meets the eye!

A city within a city, Grand Central Terminal includes some 34 miles of underground track, over 80 shops and eating places, more than 300 phone booths, an investment center, a movie theatre, and two art galleries.

Every year more than 60 million travelers pass through the train gates of Grand Central Terminal, New York City. Not many are aware of the complex organization which clears this traffic with maximum safety and minimum delay. The world's tallest subterranean signal tower controls the arrivals and departures of 500 trains a day . . . three a minute during rush hours . . . moving on 78 tracks fanned out on two levels of a 79-acre yard.

Serving travelers—in this case the nation's motorists—is also an important responsibility of Cities Service. Here, too, the biggest job is done behind the scenes. To assure customers of an unfailing supply of quality petroleum products requires a vast producing, manufacturing, transporting, research, and marketing organization.

Hundreds of millions of dollars flow annually into these far-flung operations . . . and many thousands of employees share the job which extends into four continents. It is costly . . . risky . . . arduous . . . but only in this way can the petroleum needs of the public be met—and petroleum, next to food, is the most vital product in America today.

CITIES SERVICE

Drilling and completion cost cut 36% on West Texas well

Upton County slim-hole well is permanently completed without casing to save $30,000 from conventional 7,000-ft wells in the area.

GARRETT Production Co., of Longview, Texas, recently saved about $30,000 in the drilling of a 7,079-ft well in West Texas. The saving was calculated at 36% from the normal cost of similar wells in the area. Actual cost when completed was $52,835.54 compared with a normal of $82,500.

Slim-hole drilling plus a new type of permanent completion developed by Garrett Oil Tools Division of U. S. Industries accounted for the reduction in costs. The well was completed with open hole from the 350-ft surface pipe to the producing horizon by using a 1-in. macaroni string parallel to the tubing instead of a standard casing-tubing program.

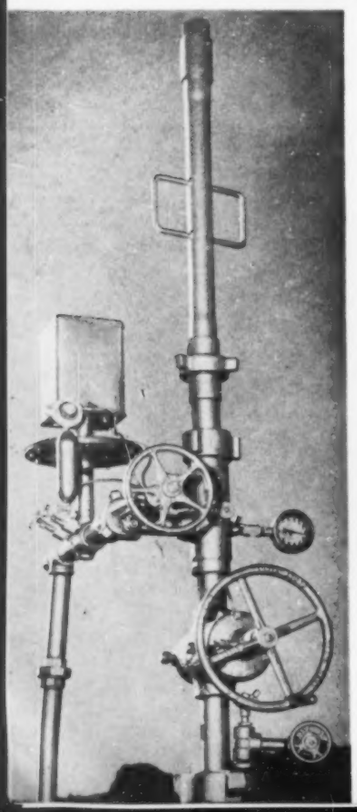
The well was drilled in 29 days without undue difficulty except for one fishing job and one case of stuck drill pipe. A light trailer-mounted rig was employed on the hole by Vaught Drilling Co., Midland, Texas. The rig has a rating of 7,000 ft with 2⅞-in. drill pipe or for servicing to 10,000 ft. With drill-collar weight of 28,000 lb, the well required thirty-three 6⅛-in. bits. The slim-hole drilling saved more than $1,000 on mud as compared with standard holes.

An accompanying diagram illustrates essential features of the equipment employed in the new completion technique. Principal elements are a perforated bull plug, tubing sub, cement-plug receiver mandrel, six sliding-sleeve gas-lift mandrels, and clamps for attaching the macaroni strung to the tubing. The well head is equipped with a special two-string casinghead; a lubricator for the free piston and intermittent valve control for piston operation; one master valve required for the tubing, and one for the macaroni string.

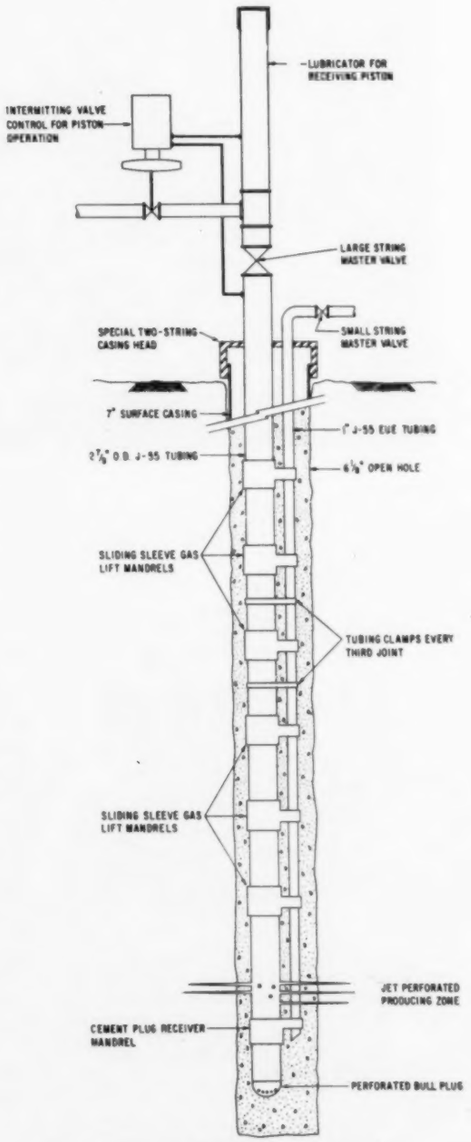
In making up the assembly, a perforated bull plug was attached to the lower end of a 10-ft sub, and the cement-plug receiver mandrel was placed on the top end of the tubing sub. The macaroni string was made up into the mandrel plug. Both macaroni and tubing strings were run in the hole together.

At a point 175 ft above the cement plug, the first of the six sliding-sleeve gas-lift mandrels was made up in the production string. Sleeves of the mandrels were packed with silicone grease and closed before running to prevent later fouling with cement. Above the first gas-lift mandrels, the remaining five were made up at 800-ft intervals. The macaroni string was connected to the gas-lift mandrels with slide couplings to allow rotation for makeup. Single-bolt

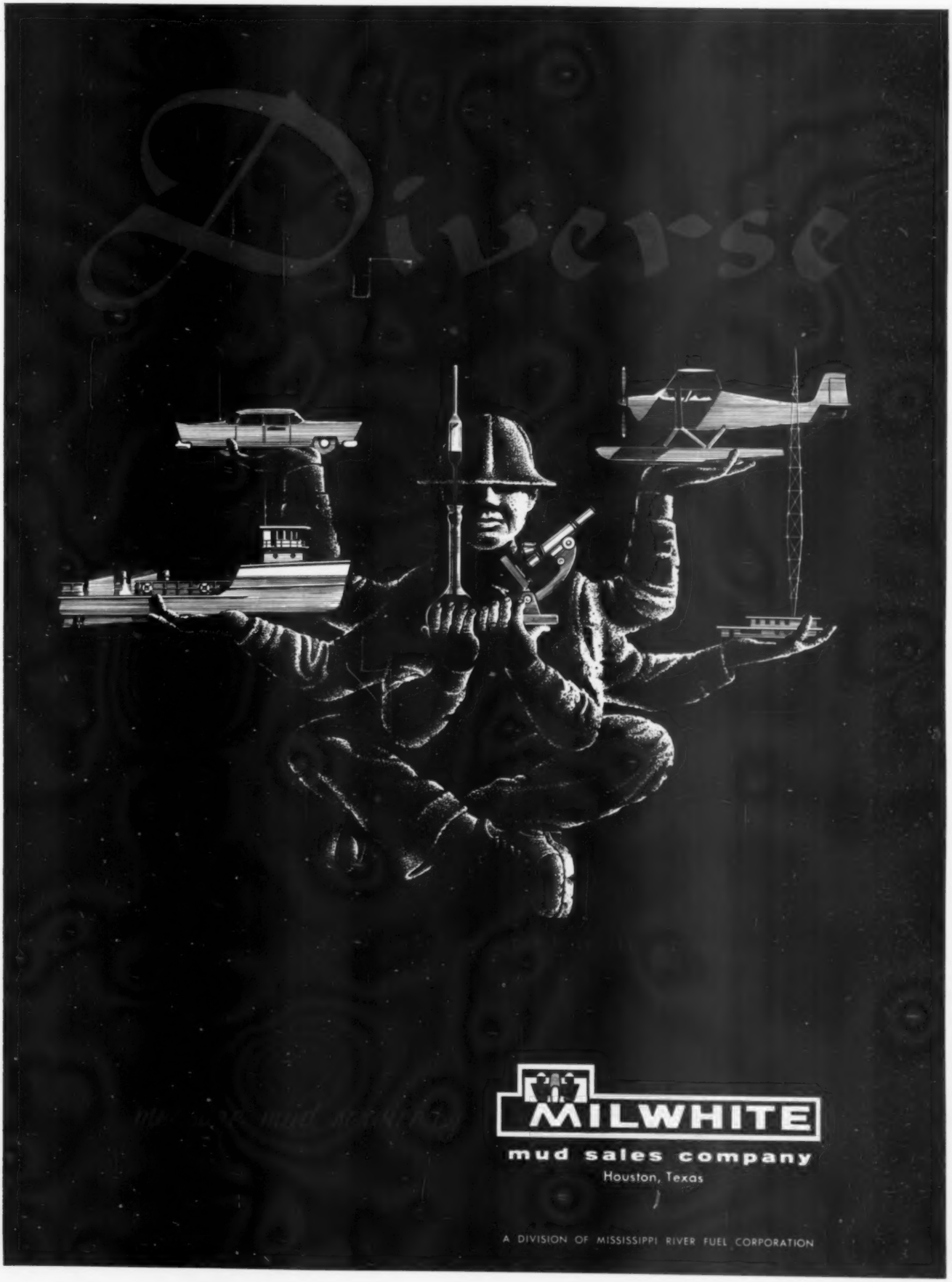
(Continued on page 76)

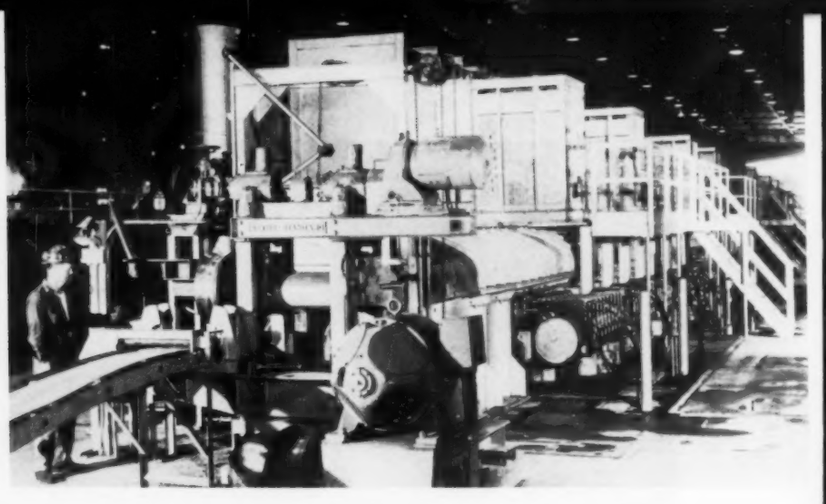


Two-string casinghead, free-piston lubricator, flow-line choke, and intermittent-flow control valve.


LUBRICATOR FOR RECEIVING PISTON
INTERMITTING VALVE CONTROL FOR PISTON OPERATION
LARGE STRING MASTER VALVE
SPECIAL TWO-STRING CASING HEAD
SMALL STRING MASTER VALVE
7" SURFACE CASING
1" J-55 EUE TUBING
2⅞" O.D. J-55 TUBING
6⅛" OPEN HOLE
SLIDING SLEEVE GAS LIFT MANDRELS
TUBING CLAMPS EVERY THIRD JOINT
SLIDING SLEEVE GAS LIFT MANDRELS
JET PERFORATED PRODUCING ZONE
CEMENT PLUG RECEIVER MANDREL
PERFORATED BULL PLUG

Schematic diagram of West Texas well assembly.


Diverse
MILWHITE
mud sales company
Houston, Texas
A DIVISION OF MISSISSIPPI RIVER FUEL CORPORATION



Coiled skelp from the 44-in. hot strip mill is passed through this furnace, heated, and then formed into pipe. Furnace shown is 190 ft 9 in. in length. The furnace on the smaller mill is 155 ft long.

Completes continuous-weld pipe mill

JONES & Laughlin Steel Corp. has put into service a basic oxygen furnace and two continuous-weld pipe mills to complete a $200 million modernization program at its Aliquippa, Pa., works. The work greatly enlarges the company's capacity to produce pipe for the petroleum industry to 35,000 tons per month.

Jones & Laughlin is the fourth largest steel producer in the USA and the first to install the basic oxygen process. The plant includes two furnaces with a capacity of 750,000 tons per year and a two-unit oxygen plant producing 230 tons of 99.5% pure oxygen per day plus nitrogen and argon by low-temperature distillation. Storage is provided for six million cubic feet of oxygen to provide a continuous supply to the furnaces under all conditions.

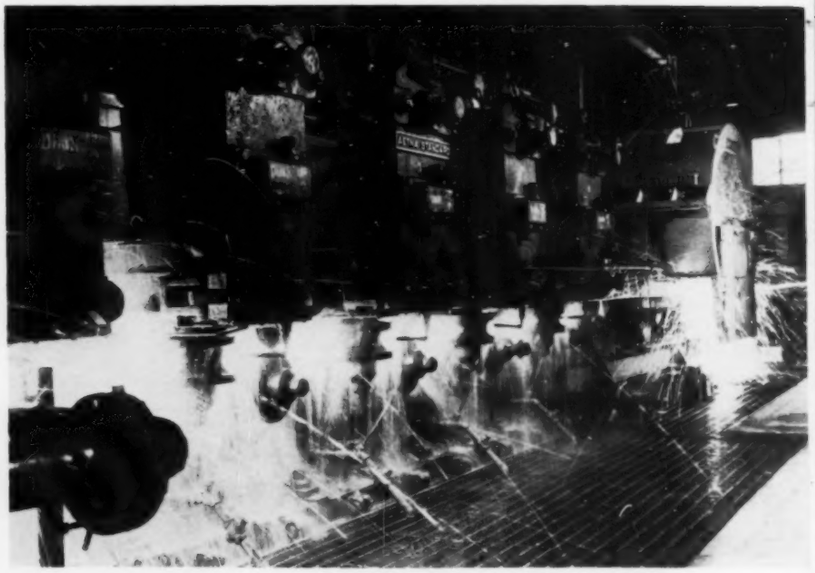
In the basic oxygen process, the converter is charged with scrap and liquid iron—after which an oxygen lance is lowered into the furnace for injecting oxygen at about 100 psi to 150 psi. About 2,000 cubic feet of oxygen are required to produce a ton of steel. In the Jones & Laughlin converter 81-ton heats are made—heats being completed on about 40-min cycles.

Steel billets from the new oxygen furnaces are sent to a new electric blooming mill, and thence to the hot strip mill which produces strip coil for the pipe mills. Coils of skelp are welded end to end to produce a continuous flow of metal of proper width and gage for the pipe to be welded.

One of the new Jones & Laughlin pipe mills produces electric-weld pipe from 4 in. to 12¾ in. in diameter at the rate of 150 ft per min. The latest mill produces pipe from 1¼ in. to 4 in. in diameter by a welding process using heat and pressure. In this mill, the continuous strip of skelp is heated to 2,450 F in 30 sec in a gas furnace before passing through the 14-stand forming and welding mill. Completed pipe is cut to length by a flying saw, and tested to 3,000 psi before shipment. All material handling throughout the mill has been mechanized. END

Coils of strip steel slit into widths ranging from 6¾ in. to 17½ in. for welding into oil and gas line pipe.

Welding and forming stands and (at right) the flying cutoff saw at new continuous-weld pipe mill of Jones & Laughlin Steel Corp., Aliquippa, Pa.



BP MAPS THE FUTURE

Minutes saved in fuelling an aircraft mean a quicker journey for its passengers. Here, at Lisbon Airport, a BP man connects a mobile dispenser to the hydrant pit of the underground pipeline. The huge plane will be completely fuelled in about 15 minutes.

1200 Gallons a Minute

ASTONISHING FUELLING SYSTEM SPEEDS THE WORLD'S AIRLINES

AIRLINERS HAVE A MAMMOTH THIRST. Today's biggest planes need as much as 18,000 gallons when they are fuelled. Tomorrow's planes will need 'fill-ups' of 24,000 gallons.

How to deliver such enormous quantities of fuel safely and at high speed sets a new problem. But that problem is being solved. Solved by the Hydrant System which, with the advice of BP, is being installed at an ever increasing number of the world's major airports.

How It Operates

Previously, fuel was always brought to an aircraft by a mobile tank fueller. Now, with the Hydrant System, it may be piped from the airfield depot direct to a hydrant on the concrete apron. From the hydrant the fuel passes to a mobile fuel dispenser which filters and controls its flow, and from this to the aircraft.

Torrential Speed

The great advantage of the Hydrant System is that virtually unlimited quantities of fuel can be delivered at *torrential speed – with complete safety*. In principle the system is simple but (particularly because of the pressures set up) to make it practicable has involved an immense amount of research and experiment by BP technicians.

This new development in aircraft refuelling is just one more way in which The British Petroleum Company plans for the future – today.

THE BRITISH PETROLEUM COMPANY LIMITED

Instrumentation for the driller

The "feel" of the brake as a guide to down-hole conditions now is supplemented by accurate instrument reports to the driller

by J. W. Knowlton

WHEN it is time to start making hole, the man at the brake is the one you must depend on. His performance is certainly dependent upon his experience and the type and condition of the rig; but, regardless of his experience and regardless of the rig, he will do a better job if he is provided with adequate instrumentation.

It is false economy to consider instruments as incidental or auxiliary equipment. Proper instrumentation is the backbone of a good drilling operation. With a complete set of instruments, any driller will be better prepared to meet emergencies and to get the most and best hole from each bit.

Particularly today, when drilling is perhaps as competitive as it has ever been, it is important that rigs stay out of trouble and that drilling time be reduced. The successful contractors are guaranteeing results by giving to their crews the best training and equipment. A complete instrument panel is an integral part of this rig; and, with the aid of these instruments, the crew will make the best use of its time and equipment. A complete set of drilling control instruments consists of the following:

The Weight Indicator: The Martin-Decker Corp. pioneered the development of weight indicators, and today offers an accurate and dependable instrument for each size rig. Its latest contribution is the "E," "D," and "F" weight indicators with the famous Sensater. These indicators provide an extremely accurate and sensitive signal to the driller, so that he has right before him the information he needs to do the best job.

Drill collars are purchased and run for a definite purpose. If the driller fails to carry the proper bit weight, then he is merely hauling collars in and out of the hole; or, perhaps worse, he is putting his drill pipe into compression. The "D," "E," and "F" weight indicators, with their added sensitivity and with the weight on the bit dial, guarantee that the proper weight is carried on the bit—and, therefore, greater drilling efficiency.

Rotary Torque—The Hydro-Mech: In recent years, the importance of rotary torque, and the knowledge of how it varies with bit life and hole conditions, have brought about great improvement in drilling efficiency. The Hydro-Mech torque gauge is indispensable to drillers who have discovered the many ways it keeps them out of trouble. The added power on modern rigs prevents the driller from "feeling" or "listening" for increased torque until it is too late.

Fishing, coring, or milling operations are greatly improved by the use of a torque gauge. It gives the operator that down-the-hole vision which takes the guess work out of the intricate operations. But the payout on a Hydro-Mech is during normal drilling operations, where the driller is kept informed by the torque gauge of his bit and hole condition, so troubles are spotted immediately and each bit gets a full and complete run.

Rotary Speed—The Electric Tachometer: Rotary speed is one rig function which often is neglected. This is unfortunate, as many tests have pointed out the importance of rotary speed to penetration. Without an indicating tachometer, the driller is not continually aware of his speed, and cannot maintain the rpm which gives him the best drilling rate.

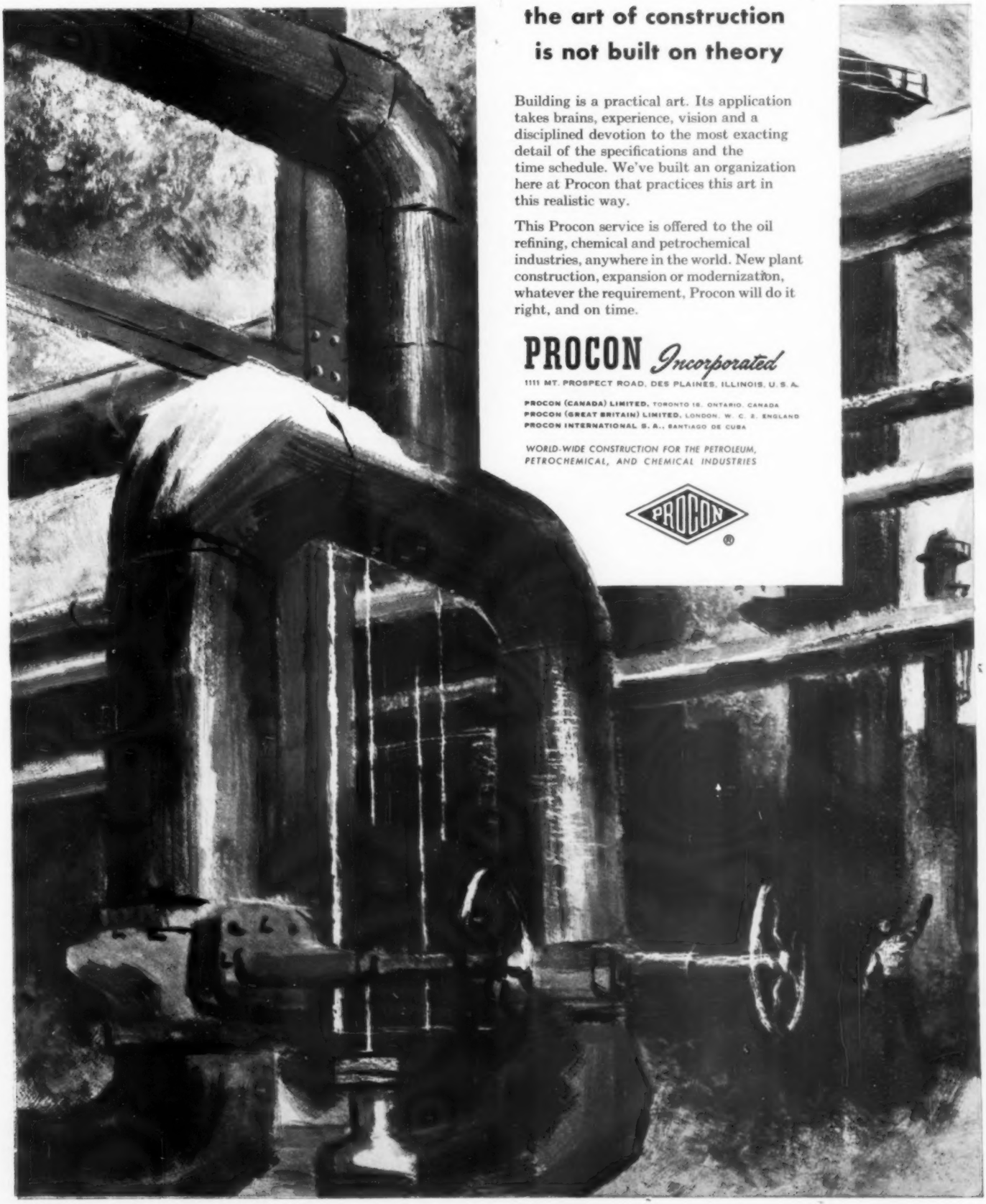
There is one speed of the rotary table which is best for each set of drilling conditions. Once the driller has found this speed, the rotary tachometer makes it possible for him to return to this optimum speed after each connection, and properly report this speed on the daily drilling report.

Pump Pressure: The value of pump pressure is known to all drilling personnel, and a highly accurate pressure gauge in the control panel permits the driller to watch closely for any pressure changes which may indicate trouble. This gauge is provided with an adjustable plusation damper, and allows the driller to set the sensitivity of the pointer to best fit the drilling conditions.

(Continued on page 79)

Jack W. Knowlton, who is in charge of domestic and foreign sales for Martin-Decker Corp., is a drilling engineer who has served in both Gulf Coast and California fields. He was with Humble Oil & Refining Co. as a drilling engineer in South Louisiana for several years, and also has served Richfield Oil Corp. in California. His degree in petroleum engineering is from Stanford University, and he holds a BS degree from the Merchant Marine Academy.

The complete Martin-Decker instrument panel for drilling control.



the art of construction is not built on theory

Building is a practical art. Its application takes brains, experience, vision and a disciplined devotion to the most exacting detail of the specifications and the time schedule. We've built an organization here at Procon that practices this art in this realistic way.

This Procon service is offered to the oil refining, chemical and petrochemical industries, anywhere in the world. New plant construction, expansion or modernization, whatever the requirement, Procon will do it right, and on time.

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WORLD-WIDE CONSTRUCTION FOR THE PETROLEUM, PETROCHEMICAL, AND CHEMICAL INDUSTRIES

PROCON ®

Active Search Continues to Improve Drilling Techniques

(Continued from page 55)

drilling full-size 17½-in. hole without ratholing ahead. A fairly large program of drilling 17½-in. and 12½-in. holes in a gas-storage field near Chicago, Ill., is now under way. Special diamond bits now under development have been tried, and have shown good performance in formations which are adapted to diamond drilling."

Drilling speeds in the USSR are improving at a substantial rate, but still are somewhat less than half the rates achieved in the United States.

In 1956, the average rig engaged in development-well drilling in the USSR logged about 104 ft per rig per day. Wildcat drilling was much slower—averaging about 37 ft per rig per day. Overall average footage per rig per day in Russia in 1956 was about 66 ft.

USA figures are not strictly comparable, since records on wildcat rigs are not segregated from development rigs. The average rotary rig in the United States drilled about 235 ft per day. Cable-tool drilling was, of course, much slower—bringing the average of all rigs down to 131 ft per rig per day.

Although Russian drilling speed is roughly half as great as in the United States, the *rate* of improvement in the two countries is roughly parallel. The turbodrill was used for about 85% of footage drilled in Russia in 1956. Large-diameter holes still are being drilled—running from 10 in. to 12 in.; but the tendency is to reduce this size.

Improvements in drilling penetration rates are being accompanied by numerous other rig development and refinements. The slush pump is being studied carefully, and new designs created. Bethlehem Supply has developed a new pump for deep jet drilling. The pump has a 16-in. stroke and, when powered with 1,800 input horsepower, will deliver 900 gpm at 2,920 psi and 82 strokes per minute. A discharge pressure of 4,570 psi can be obtained with 6-in. liners. Low weight to horsepower ratio has been obtained by new manufacturing techniques.

Cardwell Manufacturing Co. is another organization working on the mud-pump problem. It now has a multicylinder pump on test in the field, designed for low weight-to-horsepower and for high-fluid delivery.

A rotary power swivel has been developed by the Baash-Ross Division of Joy Manufacturing Co. which eliminates the conventional drilling swivel, the kelly, the kelly-drive bushing, the rotary table as a rotary device, and the compound chain drive used to rotate the rotary table. The power swivel is a rotating power-transmission device which can be attached to the upper end of the drill pipe. It can be driven hydraulically, electrically, or by air. It permits the use of multijoint stands of drill pipe to reduce the number of connections which must be made on the rig floor. Stands of 60 ft or longer can be connected into the drill string at one time—stand length being limited only by the height of the derrick.

Using the longer stands greatly reduces nondrilling time by eliminating one-half of two-thirds the time usually consumed in making rig-floor drill-string connections. In addition, it permits the cutting of longer cores, as it is not necessary to pick up from the bore face every 30 ft to make a new connection, as with conventional equipment.

As the power swivel is attached to the upper end of the drill string, it permits drilling or reaming up hole as well as drilling down.

The Baash-Ross power swivel also offers much greater control of the rotating equipment than with conventional drilling equipment, as maximum torque can be applied to the drilling string at very slow speeds, and torque can be controlled to any degree of sensitivity within practical limits.

The power generator can be located at a remote distance from the power swivel. Also, deep holes can be drilled at various angles much easier than with conventional drilling equipment, since the rotating power is applied directly at the end of the drill string.

Baash-Ross has produced units up to 160-hp which have been proved in the field. Units as large as 600-hp are being considered. One development model has gone through preliminary tests conducted for the Gulf Oil Corp. in offshore operation in Louisiana. This unit is a power sub, which is distinguished from a power swivel in that it is placed in the drill string immediately below a conventional drilling swivel and does not, in itself, sustain the load of the drill string—being only a rotating device.

Power swivels incorporate a load-carrying thrust-bearing arrangement similar to that used in conventional drilling swivels to support the load of the drill string. Also incorporated into the power swivel is the conventional drilling-fluid circulating-wash pipe in order that drilling fluids may be pumped through the drill string. Power swivels now under development will be capable of drilling to the depths now possible with conventional equipment. They will be large enough to transmit torque and speed to the drill string equal to those of convenient equipment.

The swivel may be used also for internal cutting of casing or drill pipe, drilling out sand bridges, drilling out cement plugs, drilling out obstructions in casing, deepening of existing well, and various fishing and down-hole cutting operations.

A power swivel is an integral part of an all-hydraulic rig built by Hydro Drilling Co., of Tyler, Texas. The rig has been operating for some time for slim-hole work—drilling with air. Hydraulic motors, with oil as the fluid, drive the power swivel, power slips, cable drum, and hoists. The rigidly mounted power swivel is controlled as to speed and torque by oil pressures. It may be swung to one side through a slot, to add pipe. The tripod mast is a piston-and-cylinder arrangement used for hoisting. The rig is truck- and trailer-mounted, and is being used for relatively shallow stratigraphic tests where quick moves and rigging time make a great difference in costs. The rig is designed for use with either air or fluid, and may be switched from one to the other without delay.

Drilling with air or gas as a means of speeding up penetration and solving lost-circulation problems has been growing in recent years. The application, until recently, has been limited to areas in which water-bearing formations offer no problem. Damp or weeping zones cause balling and the danger of drill-pipe sticking. One approach to this problem has been the use of foaming agents in wet wells. Recently R. M. Reed, of Shell Oil Co., reported to the API spring production meeting at Oklahoma City that flows up to 50 bbl per hour have been handled successfully in formations which do not spall badly in the presence of water. The cost of foaming agents limits application, and corrosion can be a problem.

Halliburton Oil Well Cementing Co. recently introduced two new materials for remedying the water problem. One of the products is a plastic slurry, and the other is a polymeric water gel. Still so new they have not been given trade names yet, their research designations are PC-11 for the slurry and PWG for the gel. Halliburton researchers view PC-11 and PWG—which are not related chemically—as two different ways to attack the same basic problem. PC-11 is especially effective for water shutoff in fractured formations producing moderate to large amounts of water. The use of PWG is indicated when water from a formation's true permeability, or water from a low-pressure zone, is encountered.

PC-11 consists of a thermosetting plastic and solids used as bulking agent and for fluid-loss control. The resin-base material is placed like cement slurry, either dumped with bailer or pumped opposite the formation to be treated with the Halliburton two-plus method. When the required squeeze pressure is applied, the plastic enters the formation where setting is accelerated by contact with water.

Relatively long sections of water-producing horizons can be treated with PC-11, which sets in one to three hours when it comes in contact with formation water. The resin mix which enters the formation sets up to form a material almost as hard as cement.

The other water shutoff agent, polymeric water gel or PWG, has a very low viscosity which is maintained during its pumping life and which aids entry into the true permeability of the water-bearing formation. When the material enters its setting stage, a very stiff gel forms in the formation in less than an hour. Desired pumping time can be adjusted—depending on existing well temperatures.

Field applications with both PC-11 and PWG have demonstrated that continued

drilling activity does not weaken their water-sealing properties.

Air and gas drilling in such areas as West Texas and the Four Corners has in some cases more than doubled penetration rate. Studies conducted by the American Association of Oilwell Drilling Contractors reveal that longer bit life, less damage to producing horizons, and other specific savings have resulted.

Plastic Casing Patch: A new system for repairing holes in casing in oil and gas wells has been developed and successfully field-tested by Pan American Petroleum Corp. Called a "casing patch," it is applied to the inside of the casing. It is set in place by applying thermal-setting plastic to holes or splits in the casing. The tool for applying this patch has only one principal part—an inexpensive inflatable mandrel, on which is wrapped fabric impregnated with the plastic.

The diameter and length of the mandrel can be varied to fit the size of the casing to be repaired, and to cover the area or vertical distance to be treated. Ready for use, the casing-patch assembly is composed of the mandrel, wrapped with plastic-impregnated fabric, and equipped with valves and two tubing centralizers.

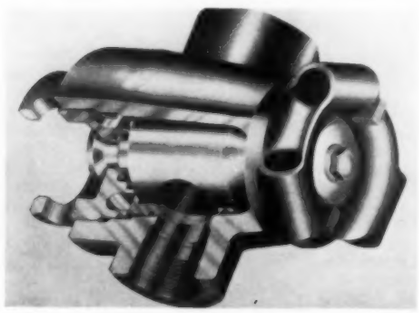
To repair a leak, this procedure is followed: Fabric strips are cut to the proper length and width to cover the mandrel. Catalyzed plastic is spread on the precut fabric strips, and these are wrapped on the mandrel. The number of strips used is determined by the size of the hole or split to be patched. The area in the well to be patched is brushed by a wire scratcher.

After attaching tubing centralizers to each end of the mandrel, the device in one type of application is connected to the tubing and lowered into the hole to the proper depth. Water or oil is pumped down the tubing string—inflating the mandrel securely against the sides of the casing, forcing excess plastic through splits or holes, and forming a seal. Under differential pressure, the plastic is squeezed through holes or splits and "rivets" itself to the casing. Inside the casing, a smooth sheet of reinforced plastic coats the walls. The assembly is left in place 12 to 24 hours, during which time the plastic becomes extremely hard. The mandrel is then deflated and removed from the well, and the repair is completed.

Of importance to production men is the fact that the casing patch can permanently seal holes and splits in casing without seriously reducing the effective inside diameter of the casing. A typical patch reduces the inside diameter of casing by about 0.6 in. It can be prepared for running into the well in less than 30 min by experienced crew men. Although Pan American personnel have lowered the assembly into wells on tubing in experimental field tests, it could be adapted to wire-line tools.

The casing patch can replace cement squeeze jobs to seal perforations; it is possible to adapt it for use in open-hole operations to isolate short sections of formation—eliminating the use of expensive casing. In well remedial operations, in addition to sealing casing leaks, it can be used to seal off highly permeable streaks in open hole to control production or injection of well fluids.

Pressure tests on a typical casing patch show effective sealing of holes up to ¼ in. in diameter at external pressures of 8,000 psi. A sample of the patch material had a tensile strength of 48,000 psi. END



Lo-Torq Plug Valves

Halliburton Oil Well Cementing Co. has designed a new Lo-Torq plug valve to handle oil-field fluids ranging from cement slurries to acids. The Lo-Torq valve only weighs 60 lb in the 2" size and 40 lb in the 1". It can be easily repaired without removing it from the line, and is readily adjusted for correct operating torque.

While the valve is used primarily by Halliburton in its oil-field services, it has a wide range of uses in drilling-mud systems and on christmas trees. On trucks, the valve is used on discharge and release lines. It is also used on squeeze cementing and testing manifolds and fracturing heads. The multi-purpose valve is most beneficial at high pressures from 10,000 to 15,000 psi.

To Increase Wire-Line Service

Great Lakes Petroleum Services Inc., wholly owned subsidiary of Great Lakes Carbon Corp., will expand its wire-line units by 50% during next six months, acording to announcement of J. T. Hancock, Jr., president of the subsidiary, and Manly B. Brown, vice president of marketing for the parent company. Decision is based on continuing favorable acceptance by the oil industry of all GLPS wire-line service, particularly recently developed thru-tubing techniques and tools, such as the retrievable swing jet gun, thru-tubing bridge plug, and dump boiler.

Principle offices of Great Lakes Petroleum Services Inc. are in New York.

G. R. Brainard

R. L. Rose

New Drilexco Directors

Drilling & Exploration Co. Inc., of Dallas, has increased its slate of directors to 12 from 10. Both new members elected are vice presidents of Drilexco. They are Robert L. Rose and Guy R. Brainard, Jr.

Solid Set Screw Limit Ring

Halliburton Oil Well Cementing Co. has designed a Solid Set Screw Limit Ring for installing accessory equipment on casing and limiting its movement without welding lugs or rings to the casing. The new, improved Halliburton ring derives its load-carrying ability from ⅜" x ⅜" hex socket head cup point set screws arranged around and through a ¼" x 1" steel band. The screws are tightened with an Allen set screw wrench, and bite into the casing—anchoring the ring and limiting travel of casing equipment. Six set screws are used on the 4½" size rings, and this number ranges up to 12 set screws for the 16" size.

New Catalog PGAC

Perforating Guns Atlas Corp. has announced the completion of its new *Catalog No. 5859*, for which requests should be addressed to the company at 7730 Scott Street, Houston, Texas.

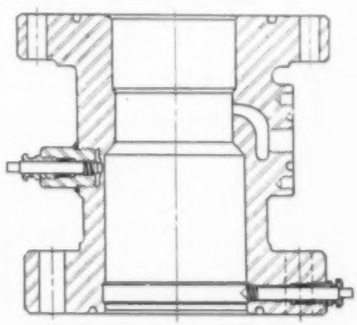
The section on "Strata-Test Formation Fluid Sampling Service" reviews PGAC's new tool which provides a quick, safe method of making a formation test on conductor line after logging, and offers sample chambers of 1-, 5-, or 6-gal capacity.

Another section, "Induction-Electrical Logging," presents details of the advantages of both induction and electrical logging, and explains the operating differences of the two types of logs.

The section on "Nuclear Well Logging" discusses in detail such subjects as: Log Temperature Stability, Zero Stability, Instrument Dependability, Log Calibration, Quantitative Evaluation of Porosities, New Logging Development, PGAC's new PH-125 Epithermal Neutron Log, etc.

The section, "Electrical Well Logging," presents log illustrations and details of the various types of electrical logs available for applications in different types of formations.

Another section, entitled "Perforating Techniques and Applications," will prove of interest to operators confronted with the problem of choosing between bullets and jets for perforating jobs. Some of the other perforating subjects discussed in that section are: Penetration Problems, Acidizing, Economics, Fracturing Problems, Casing-Size Problems, Well Temperature Problems, Combination Bullet and Jet Perforating, Evaluation of Perforating Equipment, etc.



Casing Suspension Head

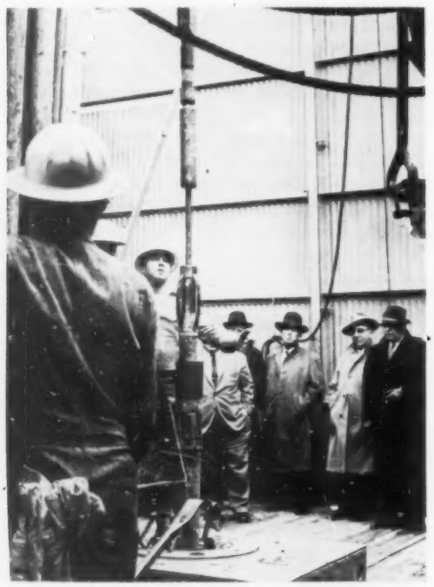
A versatile head for the suspension of casing and single, dual, or triple parallel strings of tubing has been developed by the Oil Center Tool Co. Known as the C-19-U head, the equipment also can be designed to allow the use of four parallel strings of tubing. A switchover from a single completion to a dual or triple can be made without the time and expense of installing another type head. It is equally

simple, with the new equipment, to complete singly even though a second or third zone originally was considered for completion.

Wire-Line Setting Tool

The job of setting bridge plugs and squeeze and production packers can now be done cheaper using the rig sand line with the new hydraulic wire-line setting tool developed by Halliburton Oil Well Cementing Co. The new tool may be used in wells with or without fluid; the necessary hydraulic fluid for operations is carried in the tool.

The tool contains a hydraulic jack with two pistons and cylinders—one small and one large. These components are operated by the wire line which is used to run the tool and plug or packer into the well. A back-pressure valve, for pressure buildup, is located above the setting sleeve so that hydraulic pressure applied to the sleeve by the pump is unable to release until the packer is set. A set of drag springs attached outside the tool helps prevent plug or packer from moving downhole during the pumping operation before the top slips are set.



New Halliburton hydraulic wire-line setting tool speeds bridge-plug and packer-setting operations and reduces cost because it can be run on the rig sand line.

Heads Delta Tank Sales

President Ken W. Davis, of Mid-Continent Supply Co., has announced that Ralph W. Nichols will direct all company sales and servicing activities of Delta Tank Manufacturing Co. products. Delta Tank oil-field products are distributed by Mid-Continent Supply, with headquarters in Fort Worth, Texas.

Clark Bros. Catalog

Clark Bros. Co., Olean, N.Y., one of the Dresser Industries, has published *Composite Catalog No. 151*, featuring the complete line of standard Clark products. Data are included on both centrifugal and reciprocating-type compressors, and gas turbines in the range of 1,150 hp to 9,300 hp.

OCT Unitree

Oil Center Tool Co. has introduced a sleek and compact unit for single or multiple completions which will contribute a long needed advantage of weight and height saving on christmas trees in addition to lower initial cost.

Outstanding operational benefits are centered in its unitized design featuring "built-in" valves, which eliminates numerous joints and flanges and thus minimizes leakage hazards. Also, the flexibility of the O-C-T UNITREE means that valve segments are replaceable in the field. The tree is presently available in series up to 30,000-lb test.

The O-C-T UNITREE currently being displayed is only 43 in. high. It can replace, and do a more efficient job, than a christmas tree 12 ft or 13 ft high.

Andre Blanchard

Ame Vennema

C. E. Spearing

R. D. Troutman

Vennema for Schlumberger Ltd.

Ame Vennema, vice president—personnel relations for Schlumberger Well Surveying Corp., has been elected vice president—administration and chief of staff of Schlumberger Ltd., parent company for the worldwide Schlumberger organization. Replacing Mr. Vennema will be Gordon D. Watson, who has been appointed director of personnel relations.

Heads Schlumberger Research

Andre Blanchard has been named vice president —technique—of Schlumberger Well Surveying Corp. Since joining Schlumberger in 1943, he has been head of the engineering department. He was elected vice president—engineering—in 1951. He will be in charge of the entire research and engineering program of the corporation.

J. FRED BUCY has been appointed assistant research, development, and engineering manager of the Industrial Instrumentation Division of Texas Instruments Inc., Houston, Texas. He will be in charge of geophysical product development for the industrial instrumentation division, which manufactures geophysical instruments, industrial recorders, and measurement and control systems.

Cup-Type Bridge Plug

A retrievable Cup-Type Bridge Plug has been developed by Halliburton Oil Well Cementing Co. to eliminate the need for pump trucks during setting operations, and is especially designed for high-pressure holes. The new plug may be run in alone on tubing when a temporary plug is needed for down-hole treating or for containing pressure during surface workover operations. One of its major functions, however, is for running with a suitable tool, such as the Halliburton retrievable test-treat-squeeze packer, for isolation of zones to be tested, treated, or squeezed. This combination permits straddling desired zones, so that several may be isolated individually for treating or testing—with only one trip in the hole.

The conventional high-pressure christmas tree on the left—a maze of stacked valves, connections, and hand wheels—towers over the OCT UNITREE. The latter represents Oil Center Tool Co.'s answer to the modern production challenge for high efficiency and the ultimate in streamlined compactness. Both the conventional tree and the UNITREE are 30,000-lb test units.

Spearing to Kellogg Board

Colin E. Spearing has been elected to the board of Kellogg International Corp.—with offices at Kellogg House, London, England, according to announcement of E. F. Liebrecht, Kellogg International president and vice president of M. W. Kellogg, a subsidiary of Pullman Inc.

McKee Opens Houston Office

Arthur G. McKee & Co. has opened a new sales office in Houston, Texas. Robert D. Troutman heads the new office, in the Houston Club Building, which will be devoted to petroleum refinery and chemical plant work.

Hydraulic Pumps

Sargent Engineering Corp., Huntington Park, Calif. has added 3-in. and 4-in. sizes to its line of rodless hydraulic bottom-hole pumps for use where increased production is desired. The 3-in. size with a 59 in. stroke operates to produce from 419 to 1,160 b/d. The 4-in. model, also with 59 in. stroke, operate at 940 to 1,960 b/d.

Surveys Venezuela Market

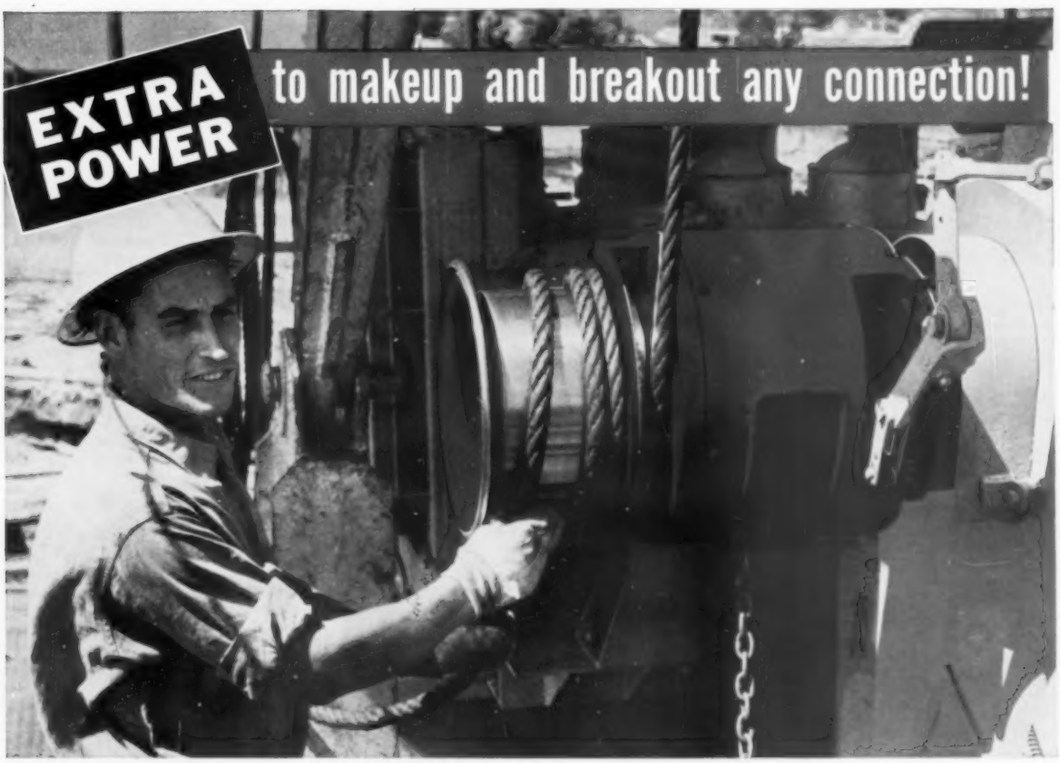
J. Pat Beaird, president of The J. B. Beaird Co. Inc., Shreveport-based manufacturer of heavy oil-field equipment, is engaged in an extended inspection and market survey trip to Venezuela. Beaird International Inc., Western Hemisphere trading subsidiary of the Beaird Co., maintains offices at Caracas, and recently made installations in Brazil, Cuba, Chile, and San Salvador. An affiliate of American Machine & Foundry Co., Beaird is part of Ammafoco, which markets products and services on a worldwide basis from headquarters in Geneva, Switzerland.

Pipe Double Jointer to Algiers

The first fully automatic pipe double jointer ever to go overseas is now en route to Africa. The Crose-Price-O-Matic unit was built by M. J. Crose Manufacturing Co. Inc., Tulsa. Working against a tight deadline, Crose performed a complete fabrication job in six weeks. The equipment layout, exclusive of crating to be done in Houston, weighs approximately 180,000 lb. It will handle pipe ranging from 22 in. to 42 in. in diameter.

The Crose unit is slated for use on a project involving 300 miles of 24 in. crude-oil pipeline from the Hassi Messaoud field in the Algerian desert to Bougie on the Mediterranean coast. Contract to construct this line represents a joint venture for two French contractors: Société Entrepose and Société Parisiènne pour L'Industrie Eléctrique.

It takes four oil-field truck loads to transport a complete and fully automatic pipe double jointer from M. J. Crose Manufacturing Co. Inc., in Tulsa, to port of Houston. Destination is port of Algiers, in Africa. There it will reload on trucks and head for the Algerian desert, where a pipeline construction project is to get under way this summer. This equipment automatically double-joints pipe and reduces by one-half the number of manual welds out on the line under construction.



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EXTRA SAFETY!
Safety stationary guard (encloses all mechanism).

Rope divider is mounted to the safety guard.

Designed for use on ANY SIZE drawworks, the American Iron "55" Cathead gives you extra power and extra safety when and where you need it. In addition, you get many outstanding advantages when you specify the Universal "55" HERE ARE A FEW:

- SIMPLE and QUICK installation.
- PRE-ADJUSTED at factory.
- SMALLER overall dimensions.
- SPIN and TONG with positive control.
- Both AIR and MANUAL controls available.
- NO SHOCK, on engagement and release.
- REMOVABLE STEEL SPOOL . . . more road clearance.

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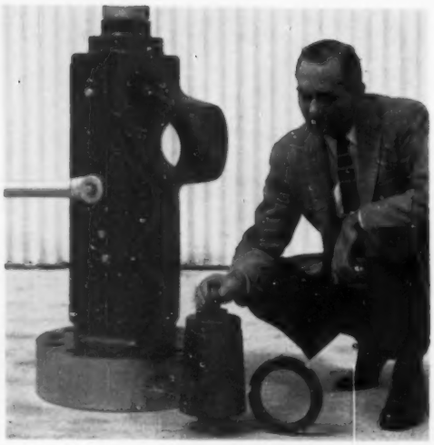


The tapered outside surface of the new Mission valve is in evidence here as Robert L. Ohls, Mission research engineer, views the valve and locking ring. Although the outside is tapered to insure the best possible seal, the core is of the straight cylindrical type.

New Mission Valve

Mission Manufacturing Co. has developed a new concept in valves for use in unitized christmas trees and for other oil-field production purposes. It is geared for ultra-high pressures, but adaptable to all pressure ranges. It has been proved in rugged field use over a period of three years.

The new valve features a balanced stem; wedge-proof, pressure seal core, and thus is non-binding. It can be operated with ease under all types of pressures and temperatures. Expansion or contraction of the valve due to internal pressure or thermal changes cannot bind the core. First adaptation of the Mission ultra-pressure valve to the integral christmas tree was in the Oil Center Tool Co. UNITREE. This was accomplished by modifying the outside of the body to fit the bores in the UNITREE.

Sequence Controller

Southwest Industrial Electronics Co. has developed a compressor start unit (CSU-1) which sequences all yard, compressor, and auxiliary valves automatically. The unit will start and bring on line a compressor on receipt of a single actuating signal. It, therefore, permits highly efficient semi-automatic operation of a compressor station from the control room. Addition of the SIE compressor-station computer controller and SIE telemetering transceivers provides a system approaching the fully automatic pipeline.

Telemetering Transceivers

Southwestern Industrial Electronics Co., a division of Dresser Industries Inc., has introduced its TTR-series Telemetering Transceivers. Designed for the transmission and reception of digital information over telephone lines, radio, or microwave links, this pulse code system provides output (without conversion equipment) for data handling, computing, printing, or supervisory control systems. TTR master and TTR-A slave units are used for remote control and central data gathering in gas and oil lease production, and for the control and monitoring of pumping, compressing, and switching operations in gas, oil, and product pipelines over any distance.

PGA Corp. Extends Services

Perforating Guns Atlas. Corp. has extended its Induction-Electrical and Electrical Logging services to the West Texas area, with operating headquarters at Odessa. PGAC has also extended its Laterolog and Micro-Laterolog services to the West Texas fields. Induction-Electrical Logging services have also been extended to the Mississippi fields, with operating headquarters at Laurel, Miss.

George Decker has been transferred to company's office at Lafayette, La., as district manager for South Louisiana. Harry B. Hacke, has returned to the company's Houston plant as assistant to James H. Russell, company's manager of operations. Robert D. Tibbs has been promoted to Oklahoma district manager at Oklahoma City.

Baroid Export Representative

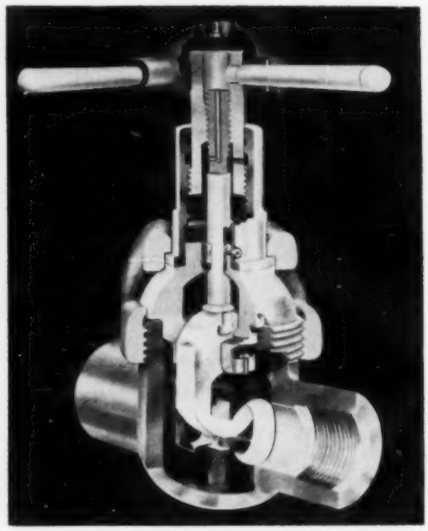
Edward Z. Walden has been appointed export sales representative for Baroid Division, National Lead Co., with offices at 111 Broadway, New York. He will serve also as sales engineer for Baroid Chemicals Inc., in the New York district.

Bent Tube Boilers

Henry Vogt Machine Co., Louisville 10, Ky., has published *Bulletin VF-VS 2*, covering bent tube boilers. The bulletin is illustrated with detailed drawings and specifications of 18 different boilers which Vogt has installed for various refineries, chemical plants, and other purposes. Included are plans for the 675,000-lb-per-hour unit recently installed for Neches Butane Products Co.

Heads Avondale Sales

A new sales development plan has been established for Avondale Marine Ways Engineering Department to provide a technical service to customers and to develop sales for its widely diverse metal-working area—including specialized industrial steel fabrication and products for the chemical and petroleum industries, as well is its general shipbuilding activity. Lamar Woodfin, who heads the activity, was formerly manager of Avondale's oil-tool division.



Mud-Line Gate Valve

Drilling Equipment Mfg. Co., Oklahoma City, has announced its new DEMCO "Mud King," a gate valve for all mud-line applications available for 2,000 and 3,000 psi working pressures, in 2-, 3-, and 4-in. sizes, with either flanged or threaded ends.

The new valve is the result of a four-year development program, including two years of field testing. The valve can be disassembled and reassembled without tools. The coupling nut can be loosened with a hammer and unscrewed, leaving the body in the line. Then the whole inner assembly can be lifted out to expose the seat and gate for inspection. All threaded parts are protected in a doubly-sealed grease chamber, the manufacturer says—pointing out that, if the stem seal becomes worn or damaged, fluid shows at specially designed signal holes in the screw housing, while the second seal protects the inner assembly from abrasives and corrosives.

For 30,000-ft Wells

A 72,000-lb pressure vessel has been installed in the new high-pressure laboratory of Schlumberger Well Surveying Corp. The vessel has a working pressure of 30,000 psi at 450 F, equivalent to hydrostatic pressures to be encountered in wells drilled well below 30,000 ft with normal drilling muds. The corporation tests all down-hole instrument housings in its high-pressure high-temperature vessels before use in the field. The vessels are also used extensively in the testing of casing perforating equipment.

E. Z. Walden

J. Lawrence

Elected Dresser Director

John Lawrence has been elected a director of Dresser Industries Inc. Formerly president of Joy Manufacturing Co., he joined Dresser as executive vice president last December.

McCullough Tool Transfers

McCullough Tool Co. has announced the following transfers: Wm. Newashe, Jr., to Cortez, Colo.; Charles E. Norton to Hays, Kans.; A. D. Wilson to Victoria, Texas; B. L. Martin to Odessa; S. E. Culwell to Headleton, Okla.; Eldon Winn to Rock Springs-Big Piney, Wyo.; D. G. Boe to Cortez, Colo.; R. N. Collum to Shreveport, La.; M. C. Gaugh to Natchez, Miss.; C. Howard to Odessa, Texas; A. Fitzsimmons to Sterling, Colo.; H. P. Burns to Farmington, N. Mex. A new service branch has been opened at Ozark, Ark.

E. R. Lindgren

B. J. Terrell

Heads Baash-Ross Engineering

B. J. Terrell has been named chief engineer for Baash-Ross Division of Joy Manufacturing Co., Houston. He will be in charge of the engineering departments of the Houston and Long Beach plants, and will supervise product design, and the new product research and development program. E. R. Lindgren has been appointed Baash-Ross Division West Coast operations manager in Long Beach.

Drilling Generators

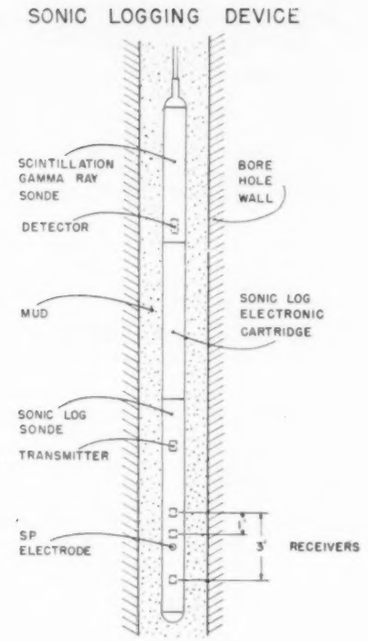
Four pages, photo, charts, diagrams, provide basic application data, specifications, operating characteristics, and features of the GE752J and GE752K oil-well drilling generators—General Electric Co., Schenectady 5, N.Y.

W-S Adds Commercial Fittings

Low-priced commercial fittings have been added to the line of products produced at W-S Fittings Works, forge and fittings division, H. K. Porter Co. Inc. Named "commercial fittings" to differentiate from regular W-S code fittings, they include hex bushings, caps, and plugs. For convenience and economy in handling, they will be packed 100 to a carton, which will be labeled gray for easy identification. W-S identifies all cartons by color-code labels for easy recognition of various pressure ratings.

Opens Maracaibo Office

A service office for the Venezuelan petroleum industry has been opened by Reynolds Metals at Maracaibo. Eugene Prestera, a petroleum engineer formerly with Mene Grande Oil Co., heads the new office. The Reynolds office will offer technical assistance in applications of aluminum. The light metal now is being used for offshore drilling platforms, flow lines, flow-station structures, and other marine facilities. The company has published a Spanish-language brochure on aluminum. Copies are available from Reynolds Metals, International Division, 19 East 47th St., New York 17, N.Y.



Sonic Logging

Schlumberger Well Surveying Corp. has introduced a sonic logging service for reservoir evaluation. Velocity measurements are recorded photographically on the standard logging film by the regular field units. The tool provides velocity data, as did the interval measurements of the past, for interpretation of seismic records; but its principal application is the determination of porosity and fluid content of the formation. It is particularly effective in establishing porosity in the low to medium ranges where other methods are least accurate.

The Schlumberger Sonic Logging device is based on prototypes developed by Humble Oil & Refining Co. Sound pulses are emitted by the transmitter at the rate of 10 or more per second, and the first arrival of energy at each receiver triggers the response system. The instrument features measurement between two receiving elements rather than between a sound source and a single receiver. This system eliminates error introduced by the time consumed in passage of the sound pulse between the instrument and the wall of hole.

The short spacing of 1 ft between receivers produces a detailed log of lithologic changes, approaching the detail of the Microlog or Microlaterolog. A third receiver placed at an interval of 3 ft gives flexibility by providing an alternate spacing.

An SP or Gamma-Ray Curve is combined with the velocity curve to give a more interpretable log, and to establish absolute depth control for comparison with other logs run in the same well.

New Schlumberger Assignments

Six new assignments and transfers involving location managers and sales engineers have been announced by the Schlumberger Well Surveying Corp.: D. G. Davis has been named manager at Cody, Wyo.; H. T. Carson is now station manager at Alice, Texas; F. A. Rice has been transferred from Alice to Falfurrias as manager. J. L. Hallman, has been transferred to Denver as senior sales engineer; W. B. Jackson, sales engineer, has been transferred from Houston to Beaumont.

Criss-Cross Safety Joint

A unique safety joint which affords right-hand release and right-hand re-engagement for retrieving the fish has been developed by Brown Oil Tools Inc., Houston, Texas. The lower pin end is provided with a right- and left-hand thread to permit right-hand release. A trip with the retrieving head which has right-hand threads permits re-engagement with the fish by right-hand rotation. The mating threads make the connection stronger than a conventional overshot.

Mr. Brown also has recently developed hydraulic set retrievable packers for single or multiple zone completions.

Any number of single-string or multiple-string packers may be run on the No. 1 tubing string. All other tubing strings are then run and landed, and the well head installed with the completion fluid in all strings and the annulus. With the well under positive control, well fluid (mud) is changed over as desired, and all zones washed in. The packers can then be set simultaneously, or set and tested individually. No wire-line manipulation is required in the setting procedure.

Venezuela Generating Plants

Venezuelan Atlantic Refining Co. is installing three generating plants at its new drilling camp in the eastern oil fields of Venezuela. Three International General Electric 300-kw synchronous generators will be powered by Cooper-Bessemer Corp. diesel engines. The generators are rated 400 rpm. 2,400 volts, three-phase, 60-cycle, 375-kva.

Waukesha Appointments

Four additions to its sales and service staffs in Texas have been announced by Waukesha Sales & Service Inc. S. W. Wacey, Wichita Falls, has been transferred to Houston as assistant to Charles O. Zagst, vice president in charge of sales. Ted Skeen has been appointed manager of engine sales at Dallas. New district manager in San Antonio is Joe Downs, and new sales engineer in Abilene is Harold F. Leavitt.

Prestressed Cylinder Piles

A new 26-page booklet describing design, construction, and installation of prestressed concrete cylinder piles has been published by Raymond International Inc., which has installed many such for offshore drilling and production facilities in Lake Maracaibo and the Gulf of Mexico. *Catalog CP-3* is available on request to Raymond International Co., 140 Cedar St., New York, N.Y.

from top

GARRETT PERMANENT COMPLETIONS REDUCE COSTS IN EVERY PHASE OF DRILLING AND COMPLETION

Think about it: 6⅛" hole rather than 9⅝"; 2½" tubing and 1" macaroni instead of a full string of casing plus tubing; the simplest of wellhead equipment rather than an elaborate multi-valve Christmas Tree. Consider these and the savings they represent and it's easy to understand how a Garrett Permanent Completion can cut your costs as much as 50%!

This unique method of well completion has been used for over two years, in wells ranging from 2000' to 8000' total depth. It has been proved wholly practicable under a great variety of bottom hole conditions. It is applicable to flowing wells and those on artificial lift. It is safe, sound and economical . . . the proven way to reduce your drilling, completion and operating costs.

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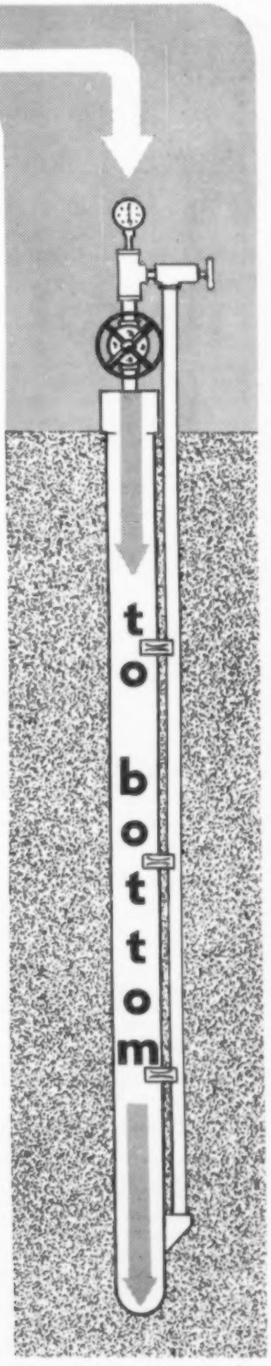


Sam D. Rogers, president and founder of Rogers Geophysical Co.

Rogers Doubles Plant

Rogers Geophysical Co. has completed an expansion program at its Houston headquarters, 3616 West Alabama St., which doubles square footage available for administration, laboratory and equipment assembly.

This is the second time since the company was founded by Sam D. Rogers that the company headquarters has been doubled. The first time was in 1952, when Rogers Geophysical was one year old. The most recent expansion adds 12,650 square feet. The company has 15 crews now operating, both in this country and in other parts of the world.

Fe Acid Cuts Formation Clogging

Halliburton Oil Well Cementing Co.'s Fe Acid is designed to help stop the plugging action of reddish-brown iron sludge which may precipitate from spent hydrochloric acid. Its application is primarily for treating water disposal and water-flood wells where deposits of iron oxides, sulfides, and hydroxides from the water have collected on the formation face. Such deposits can necessitate using high pressure to accomplish normal water injection.

Heads Otis Research

Dick M. Koons has been appointed director of the research and development department for Otis Engineering Corp., in Dallas, company officials have announced. Mr. Koons joined Otis in February of this year as a development engineer.

Sharpe Southwestern Manager

Robert F. Sharpe, branch manager in Dallas for the past eight years, and associated with White Motor Co. for 10 years, has been named regional manager for the entire southwestern region of White Motor Car Co.—in charge of White, Autocar, and Reo sales and service. Replacing Mr. Sharpe as Dallas branch manager is Howard Cordray. Claude Hoerster becomes Houston branch manager; and James E. Daniel, Jr., becomes branch manager in Oklahoma City.

Stewart & Stevenson Promotions

Five promotions and new assignments in West Texas have been made by Stewart & Stevenson Service Inc. Grady Foster has been promoted to branch manager at Lubbock, where Bob Wassom is now operations manager. Dick Brough has been promoted to district operations manager. Louis Duncan has been re-assigned to the Odessa territory as general field salesman. Dave Klager has been transferred to the eastern half of the Odessa territory—which includes Midland and Abilene.

Purification Condensate

Technical Reprint T-157: "Breakthrough in Condensate Purification," has been published by Graver Water Conditioning Co., 215 W. 14th Street, New York 11, N. Y. The paper discusses the use of the new principle of internal self-purification of condensate in subcritical as well as supercritical operations. Internal self-purification is accomplished by a scavenger-demineralizer system within the boiler turbine cycle. The result is ultra-pure feed water and condensate in the range of parts per billion instead of the usual parts per million.

L. Bruner

R. Erisken

Directs Export Sales

Jim Taylor, export manager for American Iron and Machine Works Co. Inc., has been named director of export sales. To his staff will be added an eastern director of export sales and a sales engineer. His headquarters will still be located in New York, but he will do extensive traveling to direct American Iron's increasing export market.

Raif Erisken has been named area director for Europe, the Middle East, and North Africa. His headquarters will be in Rome. Another addition to the sales staff is Leroy Bruner, special representative at Houston.

Storage Tank Catalog

Storage-Tank and Plate-Fabrication Catalog 58 G is now available from Hammond Iron Works, 744 Broad St., Newark, N.J. The fully illustrated catalog describes all types of Hammond-built storage systems, including patented floating tanks of Tube-seal or Springtite construction, Vaporlift systems, Diaflote tanks, Dialift systems, underground storage tanks, water storage tanks and treatment vessels, and the recently introduced Hamondflote Cover for small vertical tanks. Also included in the new catalog is information on Hammond's facilities for fabricating all types of steel, aluminum, and alloy plate vessels and structures.

Geophysical Associates New Home

Geophysical Associates International has occupied a new headquarters building at 3621 West Alabama St. in Houston, Texas, which contains 9,000 square feet of floor space.

Principals of the company are Dr. L. L. Nettleton, E. Joe Shimek, and Dr. Nelson C. Steenland. Operating divisions are Gravity Meter Exploration Co.; Geophysical Associates; Musket Equipment Rentals Ltd.; GMK Corp.; C. A. Associados Geofiscios Internacional de Venezuela; C. A. Exploradora Gravimetrica Associados Geofisicos Internacional SA; Geophysical Associates International Inc.; and Liberty Exploration Co.

Frac Header

Dowell Inc., Tulsa, Okla., has prepared a report on its new Frac Header for improved visual inspection and safety. Larger fluid passages have been built in to reduce horsepower loss and lower vibration. Copies are available on request.

W-S Fittings Appoints Wroten

David P. Wroten has been appointed district manager, Southeastern territory, for W-S Fittings Works, Forge and Fittings Division, H. K. Porter Co. Inc., with headquarters in Atlanta, Ga. He is primarily will assist and service W-S distributors in the states of Tennessee, North Carolina, Mississippi, Alabama, Georgia, South Carolina and Florida.

Brushless AC Generators

A complete line of 50, 60, and 400-cycle brushless alternating-current generators has been developed by Kato Engineering Co., Mankato, Minn., in both single and three-phase output. The manufacturer claims there is no possibility of sparks with these brushless alternators, as all spark-producing components have been eliminated and replaced with a system of rectifiers which change a portion of the AC output to direct current. This DC is fed to the field poles of the exciter. The AC output of the revolving armature-type exciter is in turn fed to a rectifier assembly and changed to DC, which is fed to the revolving field poles of the alternator.

J&L Supply and Continental Tank Distribution Agreement

Jones & Laughlin Supply Division, of Tulsa, and Continental Tank Co., of Oklahoma City, have announced an agreement for exclusive supply company distribution of Continental tanks throughout the oil fields of the United States, Canada, and overseas. The announcement was made jointly by Rainey Elliott, president of Jones & Laughlin Supply, and Guy O. Marchant, president of Continental Tank. Representing a major departure from traditional methods of tank distribution to the oil industry, this agreement provides J&L with a complete "package of production equipment" for the oil producer, and makes available to Continental J&L's distribution network of 82 stores and 32 offices in the oil fields. Past practice has generally been for manufacturers of tanks to sell direct to the oil producer.

Continental Tank manufactures, at Oklahoma City, a complete line of tanks—including oil and gas separators, oil treaters and heaters, salt-water disposal equipment; dehydration, metering, and testing equipment; welded tanks and bolted tanks.

Continental Tank Co. has sales offices at Tulsa, Ardmore, Chickasha, Pawhuska, and Ponca City, Oklahoma; Midland and Pampa, Texas; Hobbs and Farmington, New Mexico; Great Bend and Liberal, Kansas; and Kimball, Nebraska. The general offices are located with the plant at Oklahoma City.

Guy O. Marchant, president of Continental Tank Co., a pioneer tank manufacturer and leading figure in this industry, is well known throughout the oil country.

Jones & Laughlin supply division is one of the major oil-field supply companies, and is a division of Jones & Laughlin Steel Corp. Headquarters for the Supply Division are in Tulsa. In addition to oil-country tubular goods and wire-rope manufactured by J&L Steel, the supply division distributes Axelson sucker rods and bottom-hole pumps, Cabot pumping units, Gardner-Denver mud pumps, Ideco drilling rigs and equipment, Republic rubber products, Century electric motors, and hundreds of other supplies used daily by the oil industry.

The sales of Continental Tanks through J&L will be administered by W. O. Hardy, J&L's manager of sales—general products.

Crose Expands Sales Staff

W. H. Royal has joined the sales department of M. J. Crose Manufacturing Co. Inc., Tulsa manufacturer of pipeline construction equipment. He formerly was assistant sales manager for Browning-Ferris Machinery Co., Houston.

Padding Machine

Crutcher-Rolfs-Cummings Inc. has made major improvements in its padding machines for pipeline laying. The machine loosens and sifts dirt from the soil onto the pipe while rocks are conveyed to the working side of the ditch.

Electro-Tech Terrain Computer

Electro-Technical Labs of Houston, Texas, has designed its TC-3 Terrain Computer to simplify and speed up gravity surveying work. It practically eliminates office calculation. The Terrain Computer is designed so that observations are quickly made from the gravity station by a single operator. Readings are made directly from the scales to an accuracy of 0.01 milligals without necessity of interpolation. The scales are calibrated for an average density of 2.0 All readings are positive in sign, so that a simple addition of all readings multiplied by 0.01 gives the correction in milligals to be added to the observed gravity as read from the gravimeter.

New Fishing Tool

A new oil-well fishing tool, which retrieves junk through a hydraulic jet action, has been announced by Nedow Oil Tool Co., Houston, Texas. Its inventor, Ben Nedow, claims it has been successfully tested in fishing operations in West Texas and New Mexico. Domestically, the tool will be supplied by Houston Oil Field Material Co. Overseas sales will be handled by Ideco Division, of the Dresser industries. The tool has been designed to pick up solid cone bits, bearings, and other heavy objects without junk shots, and to clean a hole in a single trip.

Present June 26, at golf party of New York chapter of NOMADS at Haworth, N. J., were John Herold, Houston Export Crating Co.; Jerry Pinkard, Rector Well Equipment Co., Fort Worth; R. M. Cook, Cook Testing Co., Long Beach, Calif.; Mario Tossini, YPF, Argentina; Jerry Rovira, YPF Bolivia, Washington, D.C.; Tom Anderson, Standard Vacuum Oil Co., Bombay, India.

Broadens Technical Service

Chemical technical service activities of the Davison Chemical Co. have been consolidated under F. Emerson Ivey, Jr., as manager. He reports directly to R. D. Goodall, vice president and general manager of chemicals. Previously technical service men reported to product sales managers.

Mr. Ivey, formerly in charge of petroleum catalysts technical service, came to Davison in 1948 from Gulf Oil Corp.

Cartwright Joy Mfg. VP

John P. Cartwright has been elected vice president and general manager, industrial divisions, of Joy Manufacturing Co., Pittsburgh manufacturer of mining and industrial equipment. J. Y. Richards has been appointed to fill Mr. Cartwright's former position as sales manager of the industrial division.

Gas-Turbine Booklet

Bulletins No. 162 and No. 163-1 have been prepared by Clark Brothers Co., Olean, N.Y., to describe its gas turbines. *Bulletin No. 162* covers the Mark TA model, a compact 1,150-bhp gas turbine for industrial, refining, and process applications. *Bulletin No. 163-1* describes the Clark models 302 and 305 gas turbines. These 8,700-9,300 bhp units, widely used to drive pumps, generators, and centrifugal compressors, are also designed for drying or catalyst-regeneration service.

Woodfin For Avondale

Lamar Woodfin has been made general sales manager of Avondale Marine Ways Inc., New Orleans. He has headed Avondale's oil-tools department since he joined the company in 1954.

Petrofina Integrates Marketing

Integration of marketing departments of El Dorado Refining Co. and American Petrofina has been announced by J. M. Shea, Jr., vice president and general marketing manager of American Petrofina which recently acquired holdings of the El Dorado Refining Co. in its purchase of the Petro-Atlas Corp.

Sunset-McRae Merger

Shareholders of Sunset International Petroleum Corp., Beverly Hills, Calif., and McRae Oil & Gas Corp., Denver, have approved merger of McRae into Sunset.

Ethyl Fuel Price Rises

Ethyl Corp. has announced increase in the prices of "Ethyl" antiknock compounds, effective with shipments on and after July 24. The new prices, in cents per pound of tetraethyl lead content, will be: motor mix, 59.76 cents; motor plus, 60.76 cents; and aviation mix, 65.66 cents.

Magnet Cove Promotion

Promotion of David G. Willis to advertising manager of Magnet Cove Barium Corp., one of the Dresser Industries, has been announced by Willard M. Johnson, president. He succeeds Ben A. Weil, resigned. Mr. Willis will also retain his former responsibilities as publications manager.

Opens Belfast Plant

The Mission Manufacturing Co. Ltd., with sales offices in London, has put into operation a new manufacturing plant in Belfast, Northern Ireland, it was announced by Richard E. White, chairman of the overseas affiliate, and president of the Mission Manufacturing Co. Equipped with the latest machine tools from Britain, Germany and Switzerland, the new plant contains 35,000 sq. ft. of space, with 26,000 sq. ft. being devoted to manufacturing. The remaining space is used for offices.

The plant's output at this time includes Mission pistons and piston rubbers, self-sealing gland packing, piston rods, E-Z swabs, Mud Monarch valves and seats, and Silver Top valves and seats. Eventually, the output will include liners and Super-Service liner packings.

Managing director of Mission Manufacturing Co. Ltd. is Robert H. Anschutz. Mission established a sales office in London in July of 1955, with W. C. Talbert, Jr., as sales manager.

SO Indiana Refinery Coordinators

Standard Oil Co. (Indiana) has set up a new program to improve efficiency and economy of operations at its refineries. Five senior scientists of Standard's Whiting Research Laboratories have been appointed to coordinate application of research to different aspects of refining at all locations. New coordinators are: Claude O. McKinney, catalytic cracking; Waldemar R. Hertwig, catalytic reforming; John H. Lovett, alkylation and polymerization; Moses Gordon, final treatment of gasolines and other fuels; and Robert J. Austin, control and recovery of wastes.

Murphy Corp.'s Acquisitions

Murphy Corp., El Dorado, Ark., has announced completion of its acquisition of Lake Superior Refining Co. and Superior Refinery Owners Inc., Superior, Wis. Basis of exchange was six shares of Murphy common for each share of common of Superior companies, and four shares of Murphy common for each $100 principal amount of negotiable promissory notes of the Superior companies.

Rimrock International

Rimrock International Co. (Rimco) has been formed to engage in worldwide contract drilling and exploration operations. The company has acquired or agreed to acquire, directly or through subsidiaries, petroleum permits, applications for petroleum permits and licenses covering 8,655,715 net acres in France, Switzerland, Paraguay, Sicily, Tunisia, and Turkey. Rimco has also acquired four drilling rigs in the Gulf Coast area and one drilling rig in the European Mediterranean area.

W. O. White has resigned as vice president of Rimrock Tidelands Inc., largest stockholder in Rimco, and has been elected president and director of the new company. He will maintain offices in New York, at 680 Fifth Avenue.

Other directors of Rimco are Mr. Rowley, George S. Buchanan, who is vice president of exploration; Dr. Paul Gmur, prominent attorney and director of Rimco's subsidiary, Mofag Oil Exploration Co., in Zurich, Switzerland; William G. Helis, Jr., independent oil operator in New Orleans; Glenn E. Nielson, president of Husky Oil Co.; Justin R. Querbes, Jr., Shreveport insurance executive; and Harrie Shea, partner in Bear, Stearnes & Co., New York investment bankers.

Geological work has been completed and a well site selected, and another exploratory well is also expected to be drilled this year in France, where Mofag Oil Exploration Co. Ltd., Rimco's Swiss subsidiary, owns a one-third interest in the Mareuil-Sariat permit. Another Rimco subsidiary, Societa Oli Minerali, a Sicilian corporation, is the owner of a petroleum permit in Sicily and has applied for petroleum permits in Tunisia. Rimco has also agreed to acquire all the stock of Marmara Petroleum Corp., owner of petroleum permits in Turkey, subject to approval of the stockholders of Marmara's parent company.

Rimco general offices are in Shreveport, La., with executive and foreign exploration offices located in New York, N. Y. Subsidiary offices are maintained in Zurich, Switzerland, headquarters of Mofag; and in Palermo, Sicily, headquarters of SOM.

Japan-US Offshore Rig

Illustration shows Japan's first offshore oil platform which will be built in Japan through arrangement with R. G. LeTourneau Inc., of Longview, Texas. Component parts and know-how will be supplied by the Texas firm, while final construction will be at Nipponese facilities at Akita, on the main Japanese island. The $1.5 million LeTourneau contract is with the government-formed Japan Petroleum Exploration Co. Ltd., of Tokyo (also known as the "Japex" company), in which the Japanese government owns 56.5% interest. Principal nongovernmental stockholders reportedly are 14 leading oil refiners.

According to R. L. LeTourneau, vice-president of the Texas firm, blue prints and specifications for the self-contained "portable island" already are being delivered to the Japanese. The hull and legwork of the 4,000-ton platform will be built at an Akita shipyard. Approximate dimensions of this newest platform are: length, 192 ft; width, 152 ft; depth of hull, 20 ft; length of legs, 145 ft; diameter of spud tanks (feet), 35 ft; height of spud tanks, 32 ft.

For Light-Weight Slurry

A new additive for cement slurry, which lightens slurry weight down to 10 lb. per gal. and has excellent bridging properties for lost-circulation problems, is being introduced by Halliburton Oil Well Cementing Co. The material, Gilsonite Cement, is a solidified mineral processed in granular form for oil-field use. Almost as light as water (specific gravity is 1.07), it adds volume, but not weight, to the cement slurry and does not appreciably affect the setting characteristics of the slurry. Initial field use of Gilsonite Cement, made in a Texas Panhandle field by a major operator after other lost-circulation materials had failed, stopped a continuing loss of drilling fluid and cement slurry which had become a major problem.

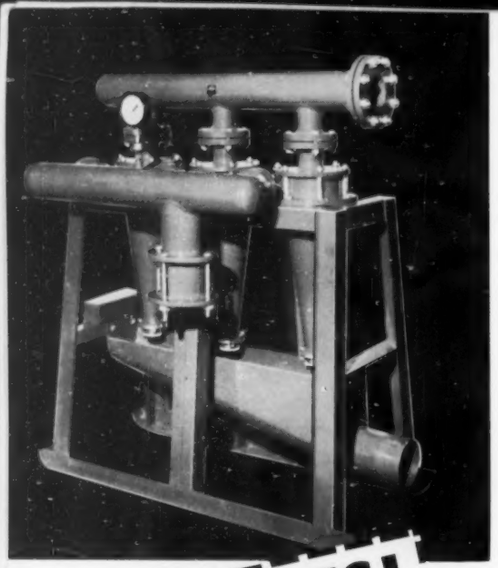
Gilsonite Cement has very low fluid requirements, and even under pressure will not take water from a cement slurry. Compounded to make an 11-lb-per-gal slurry, the compressive strength after 24 hours at 100 F is 600 psi; however, a 10-lb slurry provides acceptable strengths for lost-circulation cements in most areas.

Four Corners Geology

OIL AND GAS IN THE FOUR CORNERS has just been published by National Petroleum Bibliography, Amarillo, Texas. The cloth-bound 300-page volume is a series of articles by selected authors, compiled and edited by Paul J. Kuhn of Dallas, Texas. The Four Corners area is covered state by state, county by county, field by field. Tables, illustrations, and maps accompany the text.

Texas GTC To Increase Capacity

Texas Gas Transmission Corp. has filed with Federal Power Commission application to increase delivery capacity of the company's natural-gas pipeline system by approximately 113 million cubic feet daily. An expansion program, outlined in the application, will increase the daily deliverability from the nine-state Texas Gas system to about 1½ billion cubic feet.



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Drilling and Completion Cost Cut 36%

(Continued from page 62)

clamps were attached to the tubing string at every third joint, and the string centralized for even cementing. Running the dual string required 12 hours.

Cement was pumped down the tubing and out into the bore hole through the perforated bull plug. After the cement had set, a fishtail bit was used to drill out the quantity remaining in the tubing. The sliding-sleeve gas-lift mandrels were found to be operable as a result of the silicone-grease protection during cementing.

The cement job was tested to 3,000 psi before perforating at four holes per foot with a jet gun.

To prepare for production, the well was acidized by squeezing—after which the mud acid was removed by swabbing for eight hours. Subsequently, the formation was fractured with mud acid, oil, and sand pumped in together at 4,000 psi and subsequently swabbed for 12 hours before being put on production. Production was continued for 12 days for a thorough cleanout, and at the close of that period a free piston was inserted and the well produced through a 20/64-in. choke.

The free-piston method of utilizing gas energy to lift the oil was selected because the piston keeps the tubing free of paraffin accumulations, since its sealing element acts as a wall scraper each time it rises to the well head with its load of oil. In this particular well the piston makes round-trip about once every 40 min. The free piston is useful also in this particular well, in that it brings formation water to the surface with the oil and, hence, tends to reduce workover jobs. The elimination of casing, the simple hook-up, plus the slim-hole technique combine to create a saving of prime importance in an era of rising drilling and completion costs.

Sliding-sleeve gas-lift mandrel, with 1-in. tubing connected and tubing clamps fitted: Note the slide coupling marked on the photo.

TABLE I. WELL COST ANALYSIS—TXL No. 1-13, UPTON COUNTY, TEXAS

1. Slabs and clear location	$ 260.00
2. Contract drilling to 7,000 ft.	21,697.50
3. Surface casing—363 ft, 7-in.-OD, used	650.50
4. Mud, chemicals, and oil for drilling	3,986.73
5. Cement-surface casing and tubing strings	1,549.64
6. Gamma-ray and neutron log	1,017.49
7. Perforations-48 holes	840.42
8. Tubing-7,150 ft, 2⅛-in.-OD, J-55	6,327.75
9. Tubing-6,925 ft, 1-in., J-55, EUE	2,664.05
10. 6 gas-lift mandrels with clamps, macaroni couplings, centralizers, cement plug, and landing nipple	3,213.28
11. Royalty charge-10 cents per foot	707.00
12. Tubing-head and well-head equipment—master valves, gages, choke, etc.	844.53
13. Free piston, lubricator, tubing stop and time cycle controller	1,183.57
14. Acidizing	573.36
15. Sand, oil, and acid fracture treatment	6,851.63
16. Wire-line truck service	110.00
17. Swab truck-22 hours	308.00
18. 10 swab cups	50.00
Total	$52,835.54

A Nonfermentable Starch

(Continued from page 53)

shut down for as long as 48 to 72 hours, the development of bacteria proceeds, notwithstanding the presence of the preservative. By the use of integrated starch, these sudden flares-up of fermentation can be avoided, and bacterial growth is suppressed from the outset; so that the expense of adding large amounts of extraneous preservatives is eliminated. For it must be remembered that, when fermentation of the unprotected starch becames noticeable, the bacterial population has already reached such high levels that it becomes difficult, and sometimes impossible, to retard or suppress it, even by excessive applications of germicides, or at least with applications compatible with the maintenance of the desired qualities in the starch.

Examples* of Economic Advantages in Use of Santophen-Integrated Starch Vs. Santophen Used Extraneously in Drilling Mud

(a)	Weight of starch applied	276 lb
		276 X 5% = 13.8 lb
	Lb of Santophen integrated	
	Bbl of mud to which starch applied	46
	Gallons of mud	2,300
	Externally applied preservative at 0.5 lb per bbl	0.14% Conc. (Rated effectiveness of OBPP is from 0.1% to 2%)
	46 x 0.5 lb	23.00 lb
	A saving of	9.2 lb of Santophen
(b)	Lb of starch	355
	Lb of Santophen integrated	17.75
	Bbl mud	59
	Externally applied 0.5 lb per bbl	29.5 lb
	Saving of	11.75 lb of Santophen
	For comparison:	
(c)	The use of caustic soda to preserve starch:	
	Daily consumption:	
	Starch	205 lb
	Caustic	162 lb
	Barrels of mud	38
	Lb of caustic per bbl	4.2 lb
	% caustic on starch	79%

* Examples cited of normal additives to drilling muds were taken from Walter F. Rogers, *Composition and Properties of Oil-Well Drilling Fluids.*

Rogers [11] states that sometimes 10% of germicides on weight of starch is necessary to protect it from fermentation (1948). He cites the usages of chlorine, chlorinated lime, sodium pentachlorphenol, crude phenol, formaldehyde, etc., as other preservations used. All of these have disadvantages as being corrosive or disagreeable to handle owing to their odors and irritating action upon the skin.

SUMMARY

1. Of all the colloidal additives used in drilling fluids to reduce water loss and improve the consistency of drilling muds, starch is one of the oldest and most versatile, and the easiest to apply.

2. The susceptibility of starch to rapid deterioration by microörganisms reduces its usage at the present day to drilling operations in saturated salt, or high pH fluids, or in substrates which have been rendered bacteriostatic by the addition of germicides to the drilling fluid.

3. It has been found that a "built-in" protection can be contributed to drilling starches, so that they can be used in freshwater fluids, and do not require the substrates to which they are applied to be immunized against bacterial growth.

4. The convenience and the economy of the use of this new starch indicates that it will probably be the choice of the industry, in the near future.

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OIL COMPANY STAFF CHANGES

President **HARRY F. PRIOLEAU** of Standard Vacuum Oil Co. recently was decorated by Philippine President Carlos P. Garcia with the Philippine Legion of Honor (Degree of Officer) in recognition of Stanvac's contribution to the Philippine economy. Looking on are Philippine Ambassador Carlos P. Romulo and Consul General Raul T. Leuterio. The award, made in New York on June 23, cited Stanvac's decision to build a $33.5 million refinery on the Bataan peninsula. The citation said the project made Stanvac "the largest single United States investor in the Philippines. The construction of this oil refinery through the initiative, able leadership, and foresight of Mr. Prioleau would promote international trade and rally businessmen of the free world to invest in the Philippines, thereby helping our country in its industrial and economic development."

BRUCE C. CLINESMITH, Malverne, L. I., has been appointed deputy comptroller of Standard Oil Co. (New Jersey). He had been assistant comptroller for the past year.

H. B. BECKLEY has been named to head the Arab Development Department of Arabian American Oil Co., at Dhahran, Saudi Arabia—succeeding R. L. Cundall, retired. Mr. Beckley, went to Saudi Arabia in 1939 and from 1949 to 1954, he served as a construction superintendent for Trans-Arabian Pipe Line Co.; then returned to Aramco. In his new post he will head Aramco's efforts to encourage and assist—when asked—the Saudi Arabian enterprises needed by the company as dependable suppliers of goods and services.

ROY C. WILLIAMSON, manager of Fort Worth division, and Loren L. Ware, general superintendent of exploration in Tulsa, have been elected vice presidents of Sinclair Oil & Gas Co., Tulsa, Okla.

THOMAS C. BORLAND has been elected vice president-production and a director of Pan American International Oil Co., New York. **JACK W. HAMILTON** will be resident manager at Tehran, Iran.

Mr. Borland succeeds Charles F. Bedford, who has been recalled to Tulsa to become vice president-production and a director of Pan American International's parent company, Pan American Petroleum Corp. He moves to New York from Calgary, Alberta, where for the past three years he has been assigned as division production superintendent for Pan Am's Canadian division. In his new assignment in New York, he will have charge of engineering, drilling, and production activities.

Mr. Hamilton will move to Tehran from Caracas, Venezuela where, since late 1956, he has been resident manager for Pan Venezuelan Oil Co.

G. M. KNEBEL has been appointed to the newly created position of senior exploration advisor of Standard Oil Co. (N. J.). Succeeding him as manager of the exploration division will be **WILLIAM E. WALLIS.** Replacing Mr. Wallis as deputy manager of the exploration division will be **VAUGH C. MALEY,** formerly regional geologist.

Joining Jersey in 1924 as a geologist, Mr. Knebel served as a director, vice president, and manager of the Standard Oil Co. of Venezuela before becoming SONJ's exploration manager in 1944. He is a former president of the American Assn. of Petroleum Geologists, and has been active in encouraging youths to study geology.

Mr. Wallis has been with Jersey and its affiliates since 1930—engaged in geological and geophysical work in the USA, Mexico, Egypt, Costa Rica, Cuba, Ecuador, and Peru. Before becoming SONJ deputy manager of exploration in 1954, he was exploration manager of Creole Petroleum Corp. from 1948.

Mr. Maley joined Humble Oil & Refining Co. as a geologist in 1927, and conducted geological and geophysical work for the Jersey affiliate until 1956, when he was transferred to the parent company as regional geologist.

THOMAS L. WARK, vice president, has been appointed special assistant to George F. Getty II, president of Tidewater Oil Co. Formerly western division general manager, Mr. Wark will continue his headquarters in San Francisco. Vice president Charles R. Brown succeeds Mr. Wark as western division general manager; and Lloyd Armstrong succeeds Mr. Brown as central division general manager at Tulsa.

DENIS B. KEMBALL-COOK, a director and vice president of Shell Caribbean Petroleum Co., has been named executive vice president in charge of exploration and production for Shell Oil Co. succeeding Alan J. Galloway, who is retiring after 32 years with the firm.

Mr. Kendall-Cook joined Shell in Boston in 1932. In 1945 he joined Shell in Venezuela, and in 1950 took charge of economics, supply, and refining for the company there. He became a director of Compania Shell de Venezuela in 1953. He has held his present positions in New York since 1957.

ROBERT T. BONN has been elected treasurer of Esso Export Corp. He succeeds R. B. Stokke, who remains a director of the corporation.

DR. LEWIS G. WEEKS, who retired on May 1 as chief geologist for The Standard Oil Co. (N. J.), has announced he will offer his services as a consultant on petroleum occurrence and exploration. His offices will be at 7 Bluewater Hill, Westport, Conn.

Dr. Weeks has been engaged in geological work since 1917, following his service in World War I. From 1920 to 1924, he was with Whitehall Petroleum Corp. Ltd., in India, after which he joined the Jersey company. For the next 30 years he spent most of his time in Latin America, during part of which he was chief geologist of Standard Oil Co. of Argentina and president of Standard Oil Co. of Bolivia. He returned to New York in 1938 as chief research geologist for the Jersey company, and became chief geologist in 1954.

Among many other publications, Dr. Weeks was co-author with Wallace E. Pratt of the *History of Oil Exploration,* published by the American Petroleum Institute. He was vice president of the American Association of Petroleum Geologists in 1951, and has served on many AAPG committees.

W. E. Wallis

G. M. Knebel

H. E. Widdell

V. C. Maley

H. E. WIDDELL, president of Arthur G. McKee & Co., Cleveland, has been elected a director of Raymond International Inc., which formerly was known as Raymond Concrete Pile Co. The two companies now are associated in general engineering and construction work outside the United States.

P. M. (PAT) BROACH, vice president and manager of crude-oil purchases and supply for Suntide Refining Co., moved to Corpus Christi, Texas. His office will be at the plant site. G. E. Wynn, president of Suntide, has announced the company's Tulsa office in the first National Bldg. will be closed.

WAYNE A. PROELL has been named division director in the Standard Oil Co. (Indiana) research department, in charge of work on solid propellants used in missiles and jet aircraft.

EDWARD J. BARNES has been elected executive vice president of Macmillan Petroleum Corp., Los Angeles, Calif.—succeeding S. M. Batterson, who remains as a vice president to advise on banking and finance. **H. C. AKERBERG,** vice president—lube sales, and **S. M. THOMPSON,** secretary-treasurer, were elected directors; and **J. B. TAYLOR,** elected assistant secretary-treasurer.

FRANK L. DENNIS has been appointed to the executive staff of the American Petroleum Institute, as special assistant to President Frank M. Porter. The Washington newspaperman and lawyer will headquarter in the Institute's Washington office, 1625 "K" St., N. W. A graduate of the University of Oklahoma and Harvard Law School, he has been director of the Press and Publication Service of the US Information Service.

EDWIN L. GORHAM, Jr., has been appointed general manager of The Texas Co.'s foreign producing department (Western Hemisphere and West Africa). Formerly manager of the department, Mr. Gorham succeeds A. W. Baucum, recently elected Texaco's vice president in charge of domestic producing.

Mr. Gorham joined Texaco's producing department in 1932, and worked in Louisiana and Texas until transferred to Venezuela in 1939. He returned to New York in 1954 and was named manager of the foreign producing department (Western Hemisphere and West Africa) in 1957.

J. W. Hamilton

T. C. Borland

Dr. L. G. Weeks

D. B. Kemball-Cook

F. L. Dennis

E. L. Gorham Jr.

Instrumentation for the Driller

(Continued from page 66)

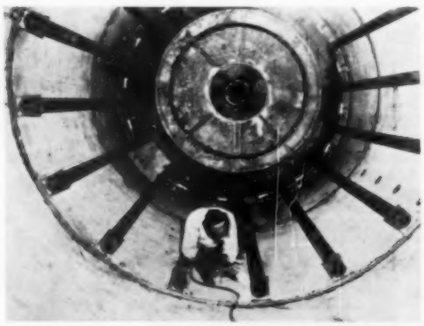
As pump pressures continue to rise, so do the problems connected with maintenance and protection of equipment. It is important to know accurately the pump pressure, and to be able to depend on this reading.

Pump Speed and Volume: Pump pressure alone does not tell the complete hydraulic story. A pressure change is of no value unless the pump speed is also available. A pump stroke-and-volume indicator alongside the pressure gauge gives the driller the combination of pressure and volume so that any troubles are quickly observed before excessive problems are encountered. But the real payout for the pump-volume indicator is that the driller is more apt to follow the hydraulic program by maintaining the proper pump speed.

Tong Torque: When you talk about tool joints, you must talk about torque—because the chief cause of tool-joint failure is improper makeup. The investment and maintenance of tool joints is one of the largest drilling costs, and the makeup of tool joints without a torque gauge is an extremely inaccurate and hazardous practice.

Many operators have practically eliminated tool-joint failures and greatly reduced tool-joint costs by using a tong torque gauge.

Recorders: The recording of various drilling functions is extremely important for the improvement of drilling efficiency. Hydraulic recording equipment for bit weight, pump pressure, and torque has recently been supplemented by a new line of electric recording instruments which record weight, pump pressure, torque, rate of penetration, rotary speed, and pump speed. END



Internal catalyst pipes are installed in first Hortonclad vessel, fabricated in 1951 at Chicago Bridge & Iron Co. Recent inspection showed this vessel still to be in good condition after seven years' severe service.

1st Hortonclad Inspected

Recent inspection of the first Hortonclad vessel ever fabricated and erected by the Chicago Bridge & Iron Co. shows the vessel to be in fine condition after seven years of severe service. The vessel, a reactor clad with type 405 stainless and monel, was placed in service at the Wichita, Kans., refinery of Derby Refining in 1951. Inspected recently during shutdown, the cladding showed only the usual microscopic pitting such as that expected in any other type of clad or solid stainless vessel—this despite extremely severe service at 1,000 F, with the cladding sheets subject to the continuous scouring action of a bead-type catalyst. Welded seams were either flush or over-flush.

Derby Refining Co. officials report that no repair of the reactor vessel had been required prior to the inspection, and none was considered necessary by the inspecting engineers who represented both the oil company and Chicago Bridge & Iron.

R. C. McDonald

D. H. Thornbury

NY Manager Clark Bros.

Clark Bros. Co., has appointed R. C. McDonald as New York district manager. He succeeds Robert J. Spears, recently appointed assistant general sales manager and transferred to the Olean, N. Y., home office. Mr. McDonald has been in charge of the Philadelphia district office since 1953.

Heads Mid-Continent Supply

D. H. Thornbury has been elected president of Mid-Continent Supply Co., and Ken W. Davis was made chairman of the board.

President Thornbury began work with Mid-Continent Supply Co. in 1929, in Houston, as district manager. A year later, he was made vice president, and later moved to Fort Worth. He had served as executive vice president and a director of the company since 1947.

3-Axle Drive Trucks

Autocar has developed a 3-axle drive truck for the primitive area of northern Paraguay for exploratory work in the region known as the Gran Chaco. Pure Oil Co. Paraguay will build 150 miles of road through dense brush and tree growth to the first drill site, 350 miles north of Asuncion. The area is completely undeveloped, and exploration calls for two preliminary wells to be started in 1958.

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International BTD 20

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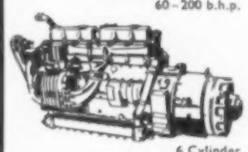
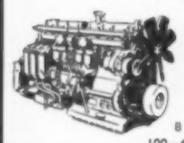
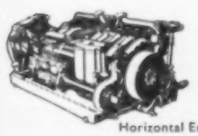
60 – 200 b.h.p.



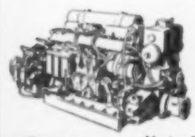
6 Cylinder
with Torque Converter
80 – 300 b.h.p.



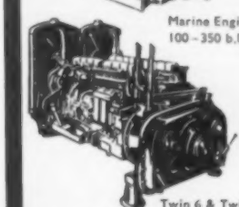
8 Cylinder
100 – 400 b.h.p.



Horizontal Engines
100 – 400 b.h.p.



Marine Engines
100 – 350 b.h.p.



Twin 6 & Twin 8
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INTERNATIONAL NEWS AND NOTES

Iraq Oil Flowing

The landing of US Marines in Lebanon and the overthrow of King Feisal's government have not disrupted oil operations in Iraq as yet. At last report, the pipelines were still uncut and the oil was flowing normally—both to the Mediterranean from IPC's field at Kirkuk and from Basrah and Mosul fields to the Persian Gulf. The new government, which has reportedly installed itself in power and eliminated either by execution or prison virtually all opposition leadership, has repeatedly expressed itself as wanting to keep the oil flowing to the West. Statements have been made by the new premier, Brigadier General Abdel Kerim Kassem, by the Baghdad radio, and by the Washington embassy of Iraq, all expressing the new government's intention to "honor all current oil agreements," and stating the government "has taken all necessary steps to safeguard oil wells, pumping stations, pipelines, and other establishments.

No accurate assessment of the situation can be reached until the situation has jelled. The new government may be extremely nationalistic, but it could easily be cognizant of its need for financial support and, therefore, refrain from interfering with the industry's operation.

Before the revolution, Iraq had contracted to supply Jordan's oil needs as part of the Arab Union. This supply was cut of, and Jordan has since been receiving its supplies from the West via air. These were to be flown in from Saudi Arabia, but reportedly that country refused permission for aerial tanker over-flights, and plans had to worked out for passing through Bahrain.

New Company For Offshore Iran

If top government go-ahead is obtained for the new NIOC-Sapphire Petroleums Ltd. agreement recently ratified by Iran's lower house, Sapphire will register a new company with NIOC, to be known as Iran-Canadian Oil Co. Sapphire interests are to spend $18 million—with $8 million in the first four years. There is no cash bonus. If there is no drilling within two years, fine will be $350,000. Iranian government will receive 75% of net profit.

Sapphire's 10,000-square-kilometer area is off the Gulf of Oman, between the consortium area and the strip operated by AGIP Mineraria.

Sapphire Petroleums Ltd. is affiliated with Sapphire American Petroleums Inc., a subsidiary. Its head office is Sapphire Petroleums Bldg., Toronto, Canada.

Offshore in Australia

Humber Oils Ltd., Calgary, has acquired an oil exploration permit covering 53,000 square miles on the Great Barrier Reef of Australia which has never been prospected for oil. It lies as far as 150 miles from the mainland, and extends 1,200 miles up the eastern coast of Australia.

Humber holds a 50% interest in the acreage which covers the major portion of the reef running along the east coast. Remaining interest is distributed among several partners, not as yet identified.

President A. W. Nauss said the company plans to drill a stratigraphic well to 6,000 ft on the reef to determine the nature of underlying beds.

Both Venezuela's distinctive modern architecture and rapid growth of Socony Mobil Oil Co. de Venezuela are symbolized by company's new headquarters building now under construction in Caracas. Structure (on left in architect's model) was designed by veteran Caracas architect Don Hatch, to harmonize with the new USA Embassy (on right, as it will appear when completed) and a third proposed office building. New headquarters is part of company's four-pronged expansion, which includes a $28 million refinery, a 209-mile crude pipeline, and new marketing facilities.

Venezuelan Sun's Successes

Two more producers bring to ten the successes of Venezuelan Sun et al, in Lake Maracaibo. SVS No. 12, larger of the two and a dual completion in multiple Eocene horizons, tested in the upper zone 5,200 b/d of 31.6-gravity oil on a ¾-in. choke, through perforations between 9,090 ft and 9,385 ft. The lower zone tested 5,160 b/d of 31.5-gravity oil, also on a ¾-in. choke, through perforations between 9,415 ft and 9,570 ft. The well encountered a total of 1,250 ft of net oil-bearing sand.

SVS No. 11, also in the Eocene, tested 5,280 b/d of 36.5-gravity oil through a ⅝-in. choke from perforations between 7,740 and 7,940 ft. It encountered 263 ft of net oil sand.

To Operate in Middle East

Drilling & Exploration Co. Inc, Dallas, will ship two new rigs to Iraq to commence drilling operations soon for IPC.

Libyan Discovery by Oasis

Oasis Oil Co. of Libya has discovered oil in its first exploratory well in North Africa, according to announcement of J. C. Donnell II, president of The Ohio Oil Co. A drill-stem test recovered 75 bbl of 30-gravity sweet oil in 2½ hours throug a ¼-in. bottom-hole choke. Interval tested was a 32-ft section between 5,822 ft and 5,854 ft.

Oasis Oil, a wholly owned subsidiary of The Ohio Oil Co., is operator of 62 million acres of concessions in Libya held in undivided one-third interests by Ohio Oil, Amerada Petroleum Corp., and Continental Oil Co. The discovery well, the No. 1 Bahi, is in north central Libya, 75 miles south of the Gulf of Sirte. It is located on a block of 1¼ million acres designated as concession 32.

Puerto Rican Oil Permit

Acquisition of oil and gas rights on more than 200,000 acres in Puerto Rico has been announced by David L. Gordon, Houston oil man and president of Maritime Oil Co. The grant includes an exploration permit and lease-selection option covering a land and offshore area on the southern coast of the island. Approximately 50,000 acres in lease properties in the 200,000-acre may be selected each year.

Italy Honors Sonj Coleman

Italy's president, Signor Giovanni Gronchi, has signed a decree awarding the "Insignia Commendatore of the Republic of Italy" to Jersey Standard director Stewart P. Coleman for his work as chairman of the Middle East Emergency Committee during the Suez Canal crisis last year. The decoration was formally presented to Mr. Coleman in Rome, July 14.

Aramco Budgets $63 Million for '58

Arabian American Oil Co. (Aramco) has announced a capital expenditures budget of $63 million for 1958. Average production of crude oil reached an all-time high of 992,114 b/d during 1957, a slight increase above the 1956 level of 986,129 b/d. On December 3, the company's cumulative production of crude oil in Saudi Arabia reached three billion barrels. Only five other countries previously had reached that mark—the United States, Venezuela, the Soviet Union, Mexico, and Iran.

Aramco estimates its proved remaining recoverable reserves at approximately 35 billion barrels at the end of 1957. Two "significant" discoveries were made, one at Khurais, 90 miles east of Riyadh, and the other at Manifa, 9 miles offshore in the Persian Gulf. Another exploratory well was "tentatively considered to prove" a 12-mile extension to the 140-mile-long Ghawar field.

The largest single item in the 1958 capital expenditure budget, Aramco announced, is a gas-injection project for the 'Ain Dar area of the Ghawar field. This project is designed to compress 200 mmcf cubic feet per day of high-pressure gas produced in association with crude oil, and to inject this gas into the producing reservoir. Total investment is estimated at $29 million.

In addition, the capacity of the existing gas-injection plant in the Abqaiq field is being increased to 210 mmcf a day. This plant injected an average of 150,236,000 cu ft a day during 1957.

Among other major projects scheduled for construction in full or in part during 1958, Aramco disclosed, are the following:

1. An expansion in the producing capacity of the Safaniya field, the first offshore field discovered in the Persian Gulf, to 175,000 b/d by the middle of this year.
2. The construction of an alkylation plant at the Ras Tanura refinery, to make possible the production of 2,000 b/d of aviation gasoline, and the expansion of liquefied petroleum gas facilities, to make possible the production of 1,500 b/d of LPGas.
3. An 800-ft extension to the north pier at Ras Tanura, to expand the terminal's capacity from eight to ten tanker berths.
4. The installation of an additional pumping unit at Nariyah, to help raise the overall capacity of the trans-Arabian pipeline system to 460,000 b/d.
5. An expansion of the water-injection facilities in the Abqaiq field, to permit the injection of 300,000 bbl of water a day to help maintain reservoir pressure.

Aramco is owned jointly by Standard Oil Co. of California, The Texas Co., and Standard Oil Co. (New Jersey)— each of which has a 30% share— and by Socony Mobil Oil Co., which has a 10% share.

Italians to Drill Offshore

The Italian government has contracted to buy a portable offshore drilling platform from R. G. Le Tourneal, Inc., of Longview, Texas. Cost of the big three-legged island will be slightly more than $1 million. It will be towed across the Atlantic.

The platform contract actually is the second entered into by LeTourneau with a foreign group in as many months. The previous month, the company announced it had arranged to furnish $1.5 million worth of "component parts and technical guidance" to a Japanese firm for a platform to drill in the Sea of Japan. The second platform was sold to SAIPEM, a subsidiary of the government-owned oil company known as Ente Nazionale Idrocarburi (ENI), headed by Enrico Mattei.

White Eagle Philippine Exploration

White Eagle Oil Co., of Tulsa, has sold $2,500,000 of stock of its subsidiary, White Eagle Overseas Oil Co. in the Manilla market. White Eagle Overseas holds 770,000 acres under oil exploration concessions in five different locations in the Philippines. White Eagle Overseas has already commenced preliminary oil exploration upon its concessions.

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PHONE MUrray Hill 4-[illegible] FOR RESERVATIONS

OUTDOOR "LABORATORY": A heavily-traveled stretch of roadway in southern England has yielded new information about asphalt road-building materials, Esso Research Ltd. reports. Four years ago, a mile-and-a-half section of the road was surfaced with 59 strips of different asphalt compositions. A recent inspection (see photo) of how well these compounds have held up showed that satisfactory paving materials can be made of asphalts from a wider variety of crude-oil sources than previously thought possible. The firm's scientists, operating from laboratories in Abingdon, are conducting similar tests with an experimental road in Sweden.

"Precon" New International Unit

Precision Exploration Consultants Ltd., and Consolidated Geophysical Surveys, both of Tulsa, have joined facilities in PRECON, a worldwide geophysical service.

Subcommittee chairmen of the scientific and technical committee for the 1959 International Petroleum Exposition Hall of Science have been appointed by George Roberts, Jr., of Pan American Petroleum Corp., general chairman of the committee.

Shown in photo with Roberts are (standing) R. M. Leader, Phillips Petroleum, petrochemical subcommittee; Henry Schaetti, Jersey Production Research Co., geological; Theodore R. Aude, Service Pipe Line Co., transportation; Harry Brown, D-X Sunray Oil Co., refining; Paul L. Lyons, Sinclair Oil & Gas Co., geophysical; and John P. Hammond, Amerada Petroleum Corp., production. Seated are B. B. Weatherby, Amerada; Messrs. Robert and John Staudt, of Dowell. The latter two were named with Dean R. L. Langenheim, of the University of Tulsa, and G. H. Westby, of Seismograph Service Corp., as consultants to the general committee.

Texas Eastern Appointments

Texas Eastern Transmission Corp. has elected three new vice presidents, John F. Lynch, Baxter D. Goodrich, and Millard K. Neptune. Paul R. Haas was made administrative vice president, and J. W. Hargrove was named financial vice president..

Chemical Plant For Marcus Hook

Olin Mathieson Chemical Corp. and Sun Oil Co. will build a 73,000-ton-a-year urea plant, at Marcus Hook, Pa.

International guests attending Houston (Texas) NOMADS at June 9 meeting were (left to right): Front row—J. W. Bradley, ex-Gulf Oil Corp.; P. C. Hovius, Cia. Shell de Venezuela; Parker, Delius, YPFB, Bolivia; D. G. Wilkin, Import Tool Co., Calgary, Canada; and C. Solis, Petroleos Mexicanos. Back row—M. F. Delano, R. S. Stokvis & Sons, New York; J. F. Dhuin and Philip des Moutis, Ste. Nationale des Pétroles d'Aquitaine; G. A. Gholamian and Homer Beklik, Iranian Oil Co.; Jacques Brisac, French Petroleum Co., Algiers; and J. P. Munier JoPain, Institut Français de Pétrole.

Weights & Measures History

A chronological review of federal legislation and congressional efforts in the general area of weights and measures for the period 1776-1956—with particular emphasis on units and standards—has been published by National Bureau of Standards. It is entitled *Circular 593—The Federal Basis for Weights and Measures: A Historical Review of Federal Legislative Effort, Statutes, and Administrative Action in the Field of Weights and Measures in the United States*, by Ralph W. Smith, June 5, 1958. It may be ordered from Superintendent of Documents, US Government Printing Office, Washington 25, D.C.; price 30 cents.

Welex Appointments

G. Turner Armstrong has been named vice president and manager of research and development for Welex Inc., with offices in the Welex Research and Development Center in Houston. The company also appointed H. B. Lee as vice president, operations.

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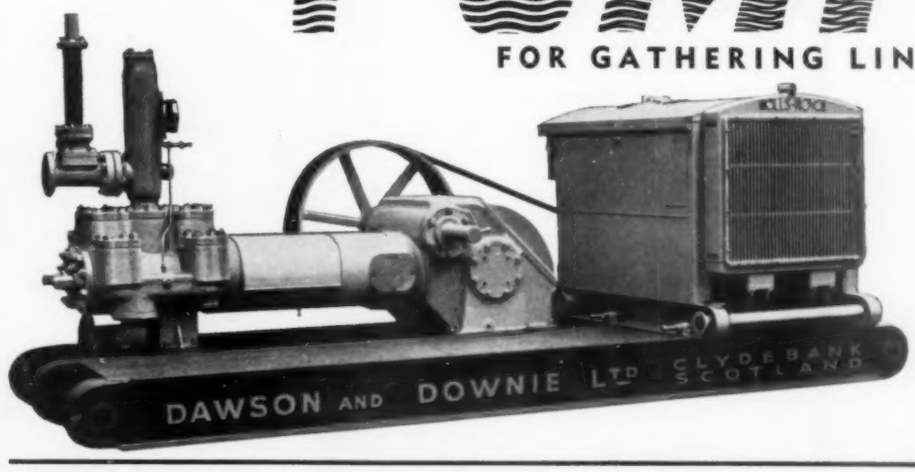

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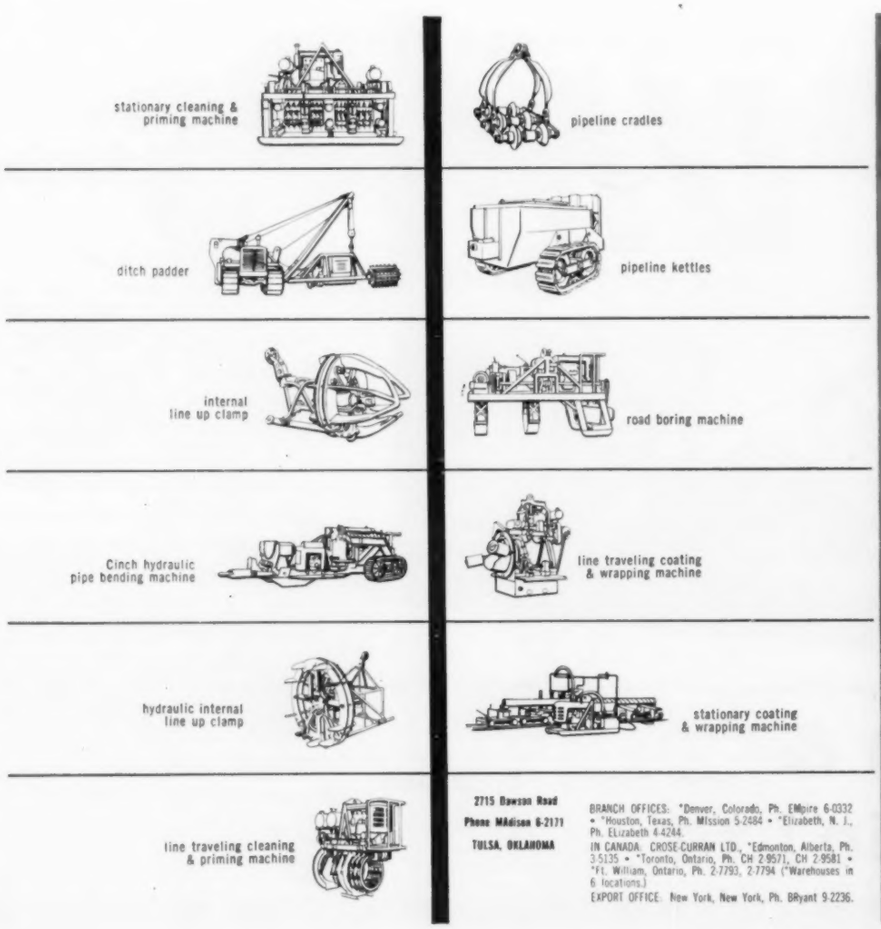
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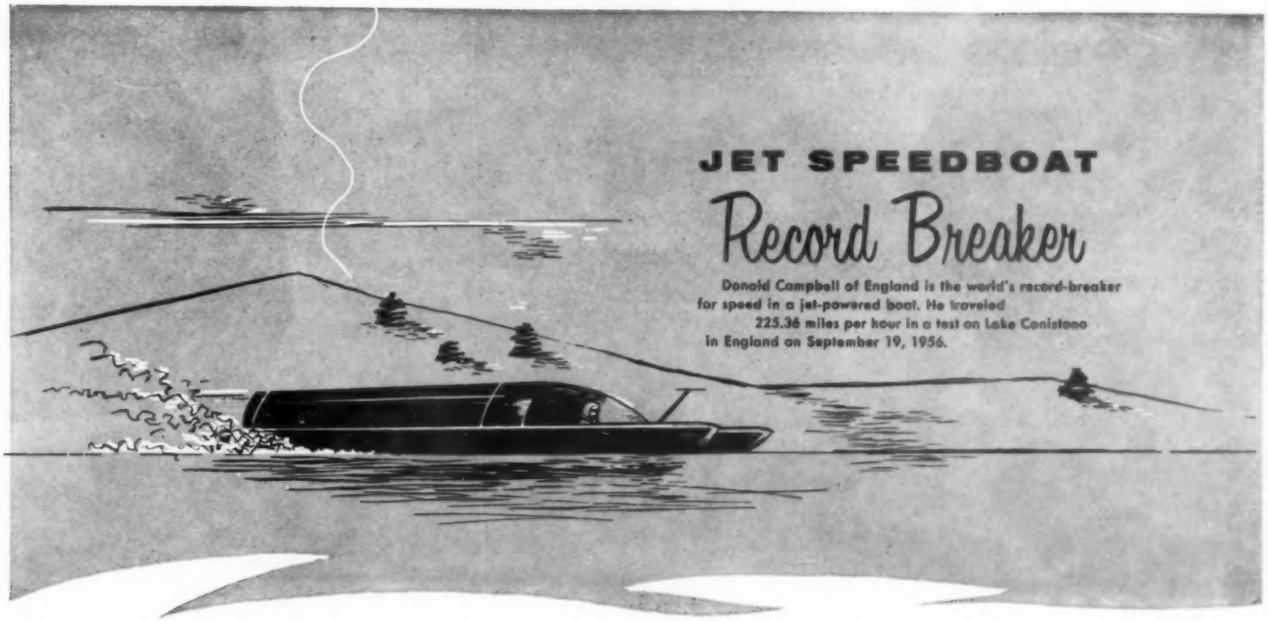

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